Use of PCM Modeling in selection of an HDTV

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Abstract

Hierarchical Decision Modeling (HDM) used with Pairwise Comparison Modeling (PCM) provides a valuable and effective tool for estimating the relevant importance of criteria contributing toward making a decision. This paper demonstrates the use of HDM and PCM in making a consumer purchase decision. For the purpose of the demonstration, five individuals were asked to rank the importance of various attributes considered when selecting a High Definition Television (HDTV). The attribute weights given the relative rankings were calculated using PCM software and summed to generate an aggregate value for the group. Twenty-seven current TV models were then selected from a list of top consumer choices and compared to the calculated weights of each attribute to select an optimal HDTV selection for each individual and for the group.

The rationale used in selecting relative attributes, building the HDM model and selecting the HDTV models are explored and explained. The model can easily be adapted with a different choice of attributes and models and the weights can be calculated for any number of individuals or groups of individuals. The result should therefore provide a simple to follow demonstration of the use of Hierarchical Decision Modeling and Pairwise Comparison Modeling in multi-criteria decision making.

Method

An HDM is a conceptual tool that enables a decision maker to apply a rational approach to decision making. It breaks a large, complicated decision problem down into many simpler sub-problems, and then provides a path for combining all the simple solutions into a comprehensive result. An HDM is also effective for reducing bias by forcing the decision maker to consider the different criteria involved in the decision independently. These independent considerations are made through Pairwise Comparisons; each element is compared to every other element to determine its relative weight, and

checked for consistency. A valid set of comparisons is highly consistent when element weights remain relatively similar when compared to the others.

The process for developing an HDM has a few basic steps. The first step is to select key criteria. This set of criteria should be limited to the most impactful set of relevant attributes considered in making the decision. Each element in the set can then be broken down into constituent sets of sub-criteria, or a set of quantitative values that represent the range of valid values for those criteria. After the model is developed, individuals dubbed as 'experts' answer the model by providing weights of relative importance for each of the qualitative and quantitative criteria as they are compared to their peers. Elements at each level are only compared to other elements at that same level.

Our method for developing the model and conclusions for this project involved many distinct processes, each with multiple levels of detail. These processes included evaluating relevant attributes, researching television options, developing the model, applying individual values and priorities, solving the model, and analyzing results. The following paragraphs will go into more detail regarding these processes to give the reader a deeper understanding of our method for implementing an HDM for this decision.

In considering attributes, we first discussed all the different ways TVs can be categorized and measured. There were a surprising number of available criteria, and we quickly determined that we would have to limit the scope of the model to a small set of key attributes. Even though a more complete suite of criteria would enable us to judge between refined nuances of individual's preferences, we determined that these differences would be dominated by the more substantial criteria, making our model unnecessarily complex without improving the decision.

Researching televisions required foot work in stores, as well as online research. Compiling the information that was available helped determine what criteria would be most helpful to the decision. It

was important that the criteria we chose to judge our TVs by were available in the same format for all TVs on the market. This was a limiting factor when developing our model, as some of the features originally considered were not available for all TV choices. After the research was complete, we developed a spreadsheet listing twenty seven HDTV choices and all their relevant criteria.

Solving the model was fairly straightforward thanks to PCM software [1] provided by the Portland State University ETM department [2]. The model was optimized by setting lower and upper bounds to the cost and screen size, specifying discrete values for refresh rate, and limiting resolution to the three most popular options on the market today. Once the model was complete, it was uploaded to the HDM software, relevant criteria and values were associated, and the URL was provided for the team to answer.

The five individuals in the group provided individual pairwise comparison weights to the criteria. The software performed the necessary calculations to determine relative values for each individual's evaluation of the criteria and for the aggregate group. This information was then compiled and applied to the selected television choices and an optimal choice was calculated for each individual and for the group. The group was very pleased by the results, as they seemed to reflect individual preferences well.

Criteria Selection

For effective pairwise comparison valuation the experts answering the model must be able to evaluate the criteria and provide a quantifiable value of relative importance. In order to apply the calculated criteria weights to the available choices each criteria must exist within a specific range. Therefore, generic non-quantifiable statements like 'elegance of design' or 'general appearance' are not valid criteria options. The criteria that are best for use in PCM modeling are:

- Values that are quantifiable

- Values that are meaningful to the end goal (select the best TV for the individual)
- Limited to a few key values, otherwise expert judgments are had to make
- Criteria that can be categorized

To adequately and accurately decide what types of criteria should be used in the construction of our HDM model, various technical specification sheets were gathered and reviewed for common characteristics. The data sheets were obtained by visiting television resellers and consumer advice websites and looking for information that was common between different television models and information that would fit into the HDM model. The group found several possibilities that at first look could meet these requirements. These common traits were all listed as possible candidates that were to be carefully considered for use in the HDM model by the project team. The initial list of criteria candidates were:

Criteria	Values
Display Technology	LCD, Plasma, LED, OLED
Screen Size	Vertical inches
Screen Resolution	720p, 1080i, 1080p
Refresh Rate	Hertz
Purchase Price	Dollars
Brand	Samsung, Panasonic, Sony, etc…
Model Year	2013, 2012, 2011, etc…
3D Technology	2D, Active 3D, Passive 3D
Reliability Rating	1 Star to 5 Star
Review Rating	1 Star to 5 Star
Screen Response	Milliseconds
Power Consumption	Watts
Interactive Features	Netflix, Pandora, Skype, etc…

Table 1 Considered Criteria

During the review process, each characteristic was reviewed with the following results:

Technology type – The decision not to use this criterion was based on the possibility of biasing. The concept that a person or expert would not choose a particular television based solely on the fact that it was of a specific type of technology is a consideration that can negatively skew the end result. The characteristic was used when the list of 27 possible televisions were selected as a way to select available choices with technology bias removed from the equation.

Brand – This criterion was not considered because of the possibility of "Brand Bias". A person that only buys a particular brand may not consider purchasing a competing brand even though the competition may offer options best suited for that consumer.

Model year – Since most resellers offer current year models, only current offerings were considered.

3-D Technology – This criterion was not selected because it was considered a nascent technology. This was based on the idea that a certain portion of purchasers would avoid 3-D technology because it is still a developing and is not mature enough to be stable. There is also, an insufficient amount of content for this type of media.

Reliability, Review, and Popularity Ratings – These criteria were not used because the data is inconsistent from one reviewer to another and not available for all options. Because of these factors, these ratings are not constant and the criteria could not be used in the HDM model.

Power Consumption and Response Time - These criteria were deemed relevant only to a small subset of consumers, namely 'green consumers' who look for energy efficient appliances and gamers looking for a highly responsive screen. Both groups were considered niche consumers and the criteria were discarded as having little relevance to most consumers.

After carefully considering each of the possible criteria the set of key criteria was narrowed to the following four.

Criteria
Price
Size
Resolution
Refresh Rate

Table 2 Key Criteria

The next step was to select the defining values for each of the four key criteria. The Cost was broken up in $400 dollar increments beginning at $200 and ending at $2200 since most popular options fall within that range. The Screen Sizes were set at 30” to 40”, 40” to 50”, and 50” to 60”. The values for resolutions and Refresh Rates were selected because they were the most common and widely accepted values recognized by the normal consumer. This information provided the group with the basis of the HDM model.

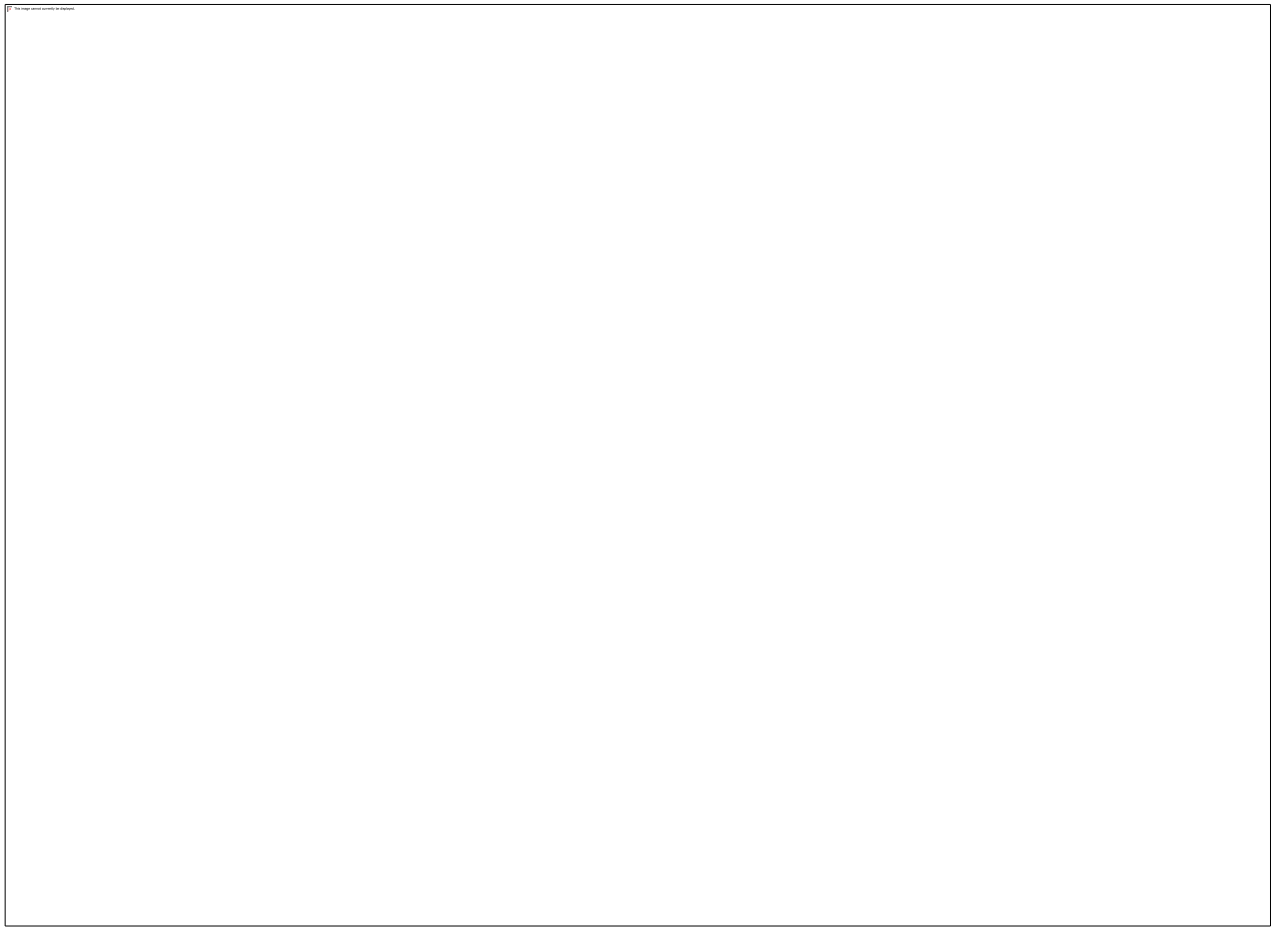

Figure 1: HDM Conceptual Model

Decision Options

To solve the HDM model the group needed to select television options. This was accomplished by going to two consumer review websites (Smartreview.com [3] and cnet.com [4]) to select purchasing options. The selection began by first going to each of the 3 different screen size groups. Within each size group three LED, three LCD, and three Plasma televisions were selected. Then a high, medium, and low priced television in each group was selected. The list of 27 televisions that resulted is shown below. The televisions' Make, Model, and Technology were not shown to the experts to reduce bias.

Make	Model	Cost	Size (in.)	Resolution	Refresh Rate (Hz)	Technology
LG	32CS460	$279.00	32	720p	60	LCD
LG	37CS560	$399.00	37	720p	60	LCD
LG	47LM6700	$949.00	47	1080p	120	LED
LG	42PM4700	$549.00	42	720p	600	Plasma
LG	50PA6500	$649.00	50	1080p	600	Plasma
LG	60PA5500	$949.00	60	1080p	600	Plasma
Panasonic	TS-L55E50	$1,299.00	55	1080p	120	LCD
Panasonic	TC-L42E50	$699.00	42	1080p	120	LED
Panasonic	TC-L47ET5	$1,092.00	47	1080p	120	LED
Panasonic	TC-L47E50	$832.00	47	1080p	120	LED
Panasonic	TC-L55ET5	$1,299.00	55	1080p	120	LED
Panasonic	TH37PR11UK	$599.00	37	1080i	600	Plasma
Panasonic	TC-P46X3	$695.00	46	1080p	600	Plasma
Panasonic	TC-P55ST50	$1,649.00	55	1080p	600	Plasma
Samsung	UN32ES6500	$698.00	32	1080p	120	LED
Samsung	UN40EH6000	$549.00	40	1080p	120	LED
Samsung	UN46EH6000	$599.00	46	1080p	120	LED
Samsung	UN55EH6000	$799.00	55	1080p	120	LED
Samsung	PN43E450	$397.00	43	720p	600	Plasma
Samsung	PN51E550	$839.00	51	1080p	600	Plasma
Samsung	PN60E550	$1,297.00	60	1080p	600	Plasma
Sharp	LC52LE835U	$2,122.00	52	1080p	240	LED
Sony	46HX850	$2,072.00	46	1080p	240	LED
Sony	KDL46HX750	$1,100.00	46	1080p	240	LED
Sony	KDL55HX750	$1,498.00	55	1080p	240	LED
Toshiba	50L2200U	$599.00	50	1080p	60	LED
Visio	E3D32OVX	$368.00	32	1080p	60	LCD

Table 3 : Purchasing Options

HDM Solution

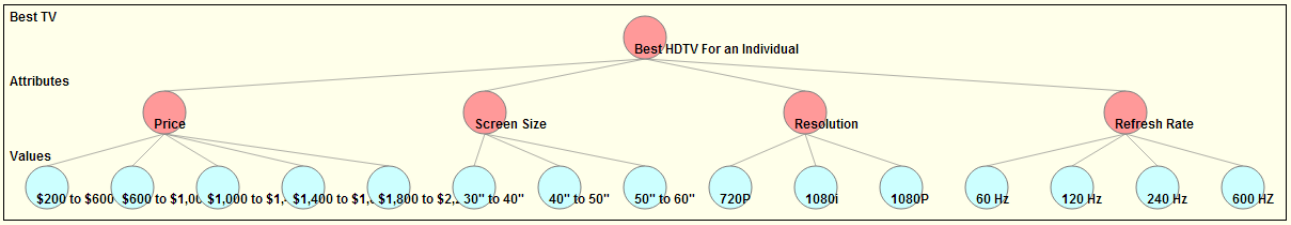

Figure 2: HDM Software Model view

Once the HDM model was built and the primary criteria selected, the model was loaded into the HDM Model software [1] created for the Portland State University Engineering and Technology Management department. The software provides a graphical representation of the HDM model and a method for 'experts' to provide opinions at each level of the model.

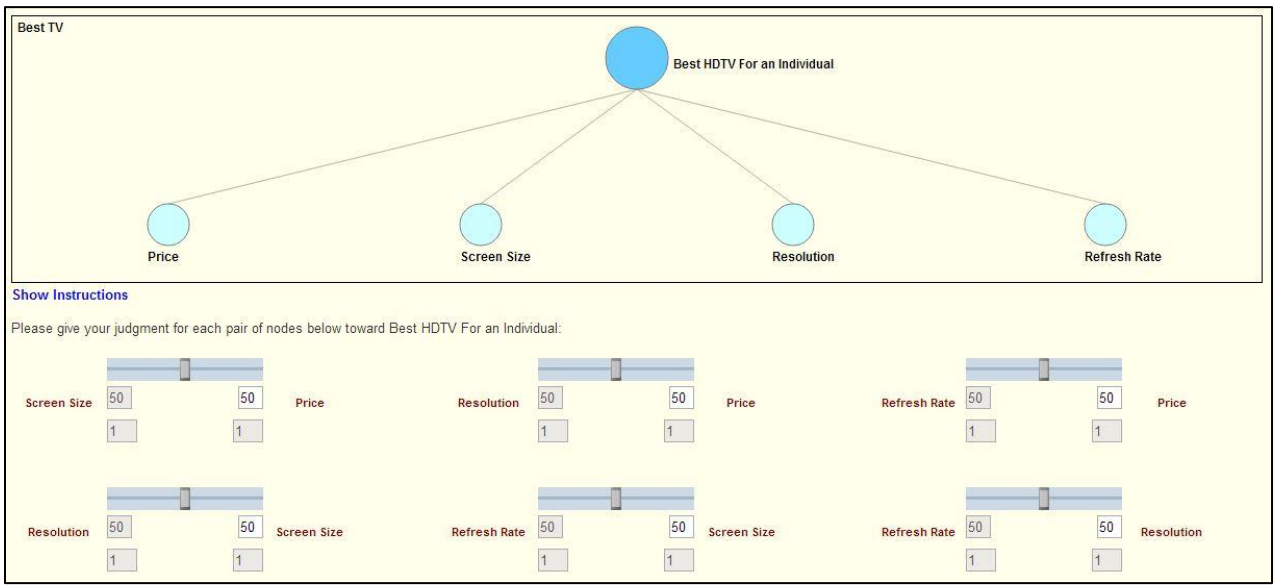

Figure 3: HDM Software Node View

The URL for data entry to the model was provided to each member of the project team and they each contributed pairwise comparison weights for the model at Level 2 (Attributes: Price, Screen Size, Resolution and Refresh Rate) and at Level 3 (Values for each criteria). Each team member was asked to consider what was most important to them in selecting an HDTV as they rated each pairing. An assumption was made that because of the variety of personalities in the team, the model would

produce different weights for the different individuals and an aggregate weight value for the team as a whole. Those assumptions were validated by the HDM results.

HDM Results

Best HDTV For an Individual	Inconsistency
Philip Bottjen	0.04
Leopoldo Marino	0.01
Noppadon Vannaprapa	0.01
Rodney Danskin	0.04
Thanaporn Ngarmnil	0.07
Disagreement	**0.04**

Table 4 Individual Consistency

Once each individual has provided relative values for the criteria being evaluated the results can be analyzed. After getting the result (Table 4) from the HDM software, we found that individual judgments and overall judgments (Table 5) have an inconsistency value of .1 or less [5] . It means that all of the value is valid for each individual.

Best HDTV For an Individual	Price					Screen Size			Resolution			Refresh Rate			
	$200 to $600	$600 to $1,000	$1,000 to $1,400	$1,400 to $1,800	$1,800 to $2,200	30" to 40"	40" to 50"	50" to 60"	720p	1080i	1080p	60 Hz	120 Hz	240 Hz	600 HZ
Philip Bottjen	0.05	0.08	0.07	0.06	0.05	0.03	0.06	0.2	0	0.06	0.22	0	0.01	0.03	0.08
Leopoldo Marino	0.01	0.02	0.02	0.01	0.01	0.04	0.1	0.16	0.03	0.12	0.39	0.01	0.02	0.02	0.04
Noppadon Vannaprapa	0.06	0.14	0.09	0.08	0.06	0.07	0.13	0.05	0.03	0.06	0.15	0.01	0.01	0.04	0.03
Rodney Danskin	0.09	0.04	0.04	0.02	0.01	0.14	0.06	0.03	0.02	0.13	0.11	0.01	0.09	0.09	0.11
Thanaporn Ngarmnil	0.01	0.01	0.02	0.02	0.04	0.05	0.15	0.34	0.03	0.07	0.18	0.02	0.02	0.03	0.03
Mean	**0.04**	**0.06**	**0.05**	**0.04**	**0.03**	**0.07**	**0.1**	**0.16**	**0.02**	**0.09**	**0.21**	**0.01**	**0.03**	**0.04**	**0.06**
Minimum	**0.01**	**0.01**	**0.02**	**0.01**	**0.01**	**0.03**	**0.06**	**0.03**	**0.02**	**0.06**	**0.11**	**0.01**	**0.01**	**0.02**	**0.03**
Maximum	**0.09**	**0.14**	**0.09**	**0.08**	**0.06**	**0.14**	**0.15**	**0.34**	**0.03**	**0.13**	**0.39**	**0.02**	**0.09**	**0.09**	**0.11**
Std. Deviation	**0.03**	**0.05**	**0.03**	**0.03**	**0.02**	**0.04**	**0.04**	**0.11**	**0.01**	**0.03**	**0.1**	**0.01**	**0.03**	**0.02**	**0.03**

Table 5 Individual Weights

Next, the researchers considered comments provided by the experts. For the first participant, Philip (movie watcher and gamer), resolution and screen size are most important and with higher values preferred. He also considered the optimal cost for his TV to be between $600 and $1,000. The second

participant, Leopoldo wanted a TV for his living room that could be viewed by a group. He was highly concerned about high resolution and a large screen size, and was little concerned with refresh rate or cost. The third participant, Noppadon who had limitations on money and space, needed a TV of a medium size and price. The fourth participant, Rodney wanted a second TV to be used in his bedroom. He considered all criteria at nearly the same level, but favored a low price and small screen size. The last participant, Thanaporn wanted a TV for her living room, was not very concerned about price or refresh rate, but was really interested in size and resolution. Detailed values for each individual are available in Appendix B

After analyzing the values provided by each participant, we are able to determine 4 different consumer types who would directly benefit from this HDM model.

1. **Cost concerned consumers**

   Since TV price is a key criteria being evaluated, buyers who have significant cost concerns benefit by using this model. Buyers in this group will consider price as a priority first before looking at the other factors.

2. **Technical specification concerned consumers**

   Three of the four key criteria evaluated are technical specifications; size, resolution, and refresh rate. Thus, consumers who are mostly concerned with performance specifications will get a significant benefit from this. Buyers with this concern tend to buy the exact TV they want, regardless of the cost.

3. **Specific use concerned consumers**

   Many people have specific constraints to deal with, usually fixed upper or lower bounds on size or cost. For example, a buyer may just want a TV for their bedroom which has only enough space for a small or medium set. Another example could be a buyer who only plans to watch action movies, he or she may prefer a TV with a high refresh rate.

4. **Mixed concerned consumers**

   Most consumers however are likely to be in this group. That is to say, prefer a balance between the different criteria, as they all affect the experience that is enjoyed from the TV. In other words, these people mix cost, technical and specific use concerns, all with different weights to find their ideal TV. This also enables the model to be used to help buyers choose TV that is suited to their individual purpose.

In summary, this model assists many different types of TV buyers in their choice of a TV that meets their needs by using a simple, broadly effective method.

Conclusion

The decision problem of how to choose an HDTV was selected because it provided a good example of a choice with multiple criteria that had to be weighed against each other and multiple choices that fit those criteria. An assumption was made that an HDM would be effective in presenting important decision factors in an organized array so they could be evaluated. PCM was assumed to be an effective way to quantify the relative importance of these decision factors. Once the values were evaluated and the model utilized in the decision making process both assumptions were effectively demonstrated and the methodology validated. The team is confident that the model, once solved, was able to effectively either select a choice for each individual or at least narrow the choice down to a few key alternatives. In addition the model proved effective for making an aggregate selection for a group of individuals.

An unforeseen benefit provided by the method used is the flexibility with which it can be adapted and reused. In the case of the HDTV selection process the software used by the team to calculate relative criteria weights can just as easily be used by any other individual attempting to make the same decision to derive quantified personal weights. This ease of use also extends easily to groups

of individuals. Instead of providing the model evaluation URL to the members of the team it could also have been provided to the members of a gaming community, or a movie watching club or pretty much any other group of individuals, enabling their aggregate scores to be derived and evaluated against the decision options.

The options being evaluated can also be expanded with great ease. Once the analysis spreadsheet was programmed to assign scores to HDTV choices depending on the calculated values of their criteria attributes it was realized that additional choices could be added with great ease. A consumer faced with the decision of selecting an HDTV model that meets his or her needs could replace the models selected for this demonstration with current choices, or perhaps choices available at a local retail store.

So long as the decision being made can be broken down into key, quantifiable values, HDM and PCM provide an effective and flexible tool for comparing the available choices. The decision of which HDTV to select provides an effective example of how these tools can be applied to the decision making process. This example will hopefully prove to demonstrate the usability of the method and the ease and flexibility with which it can be applied.

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[4] CBS Interactive Inc., "Televisoins," CBS Interactive Inc., 2013. [Online]. Available: http://reviews.cnet.com/televisions/. [Accessed 16 2 2012].

[5] D. F. Kocaoglu, "HDM computations," *Portland State University,* no. Winter ETM 530 Slides and Handout, 2013.

Appendix A: HDM Model Views and Results

Model view for experts

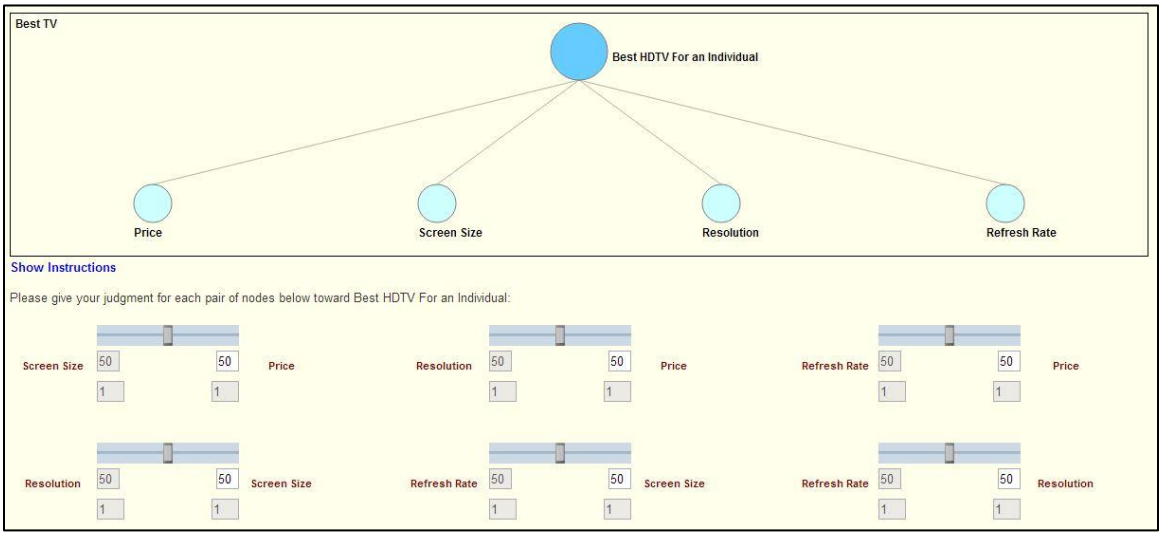


Figure 3: Level 2 - Attributes

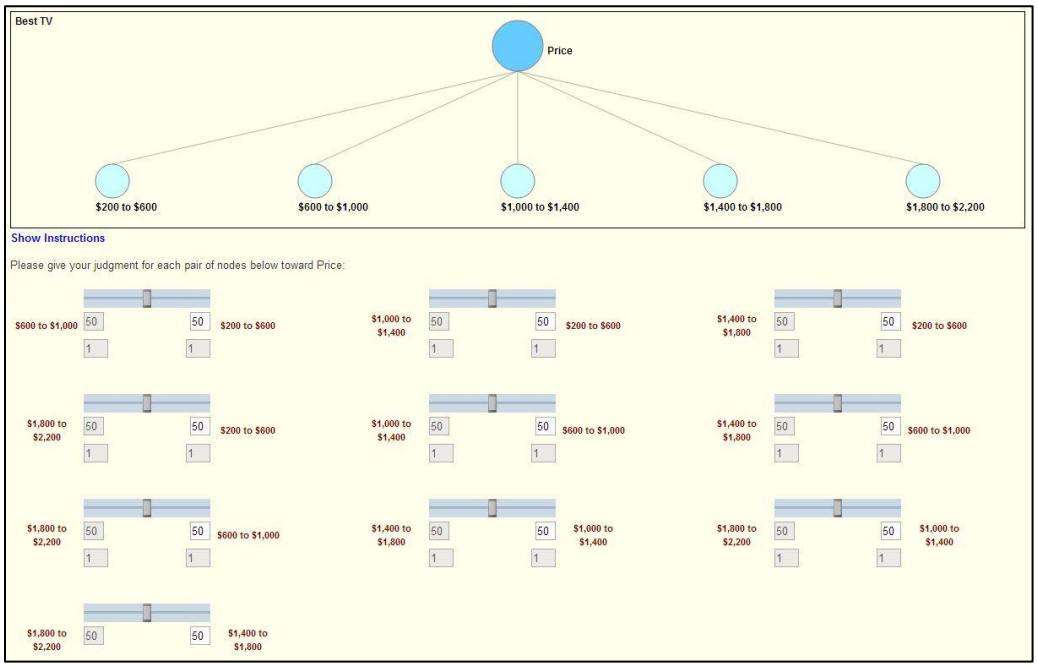


Figure 4: Level 3 – Price comparisons

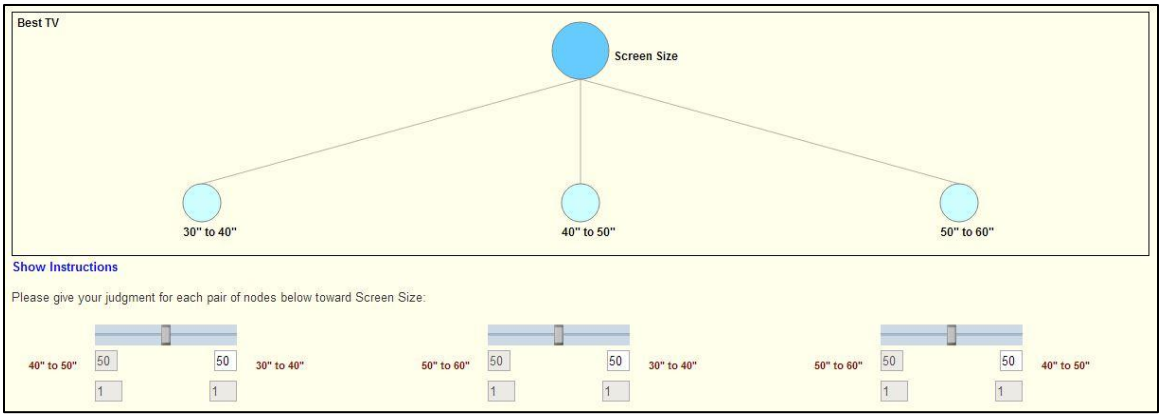


Figure 5: Level 3 – Screen Size comparisons

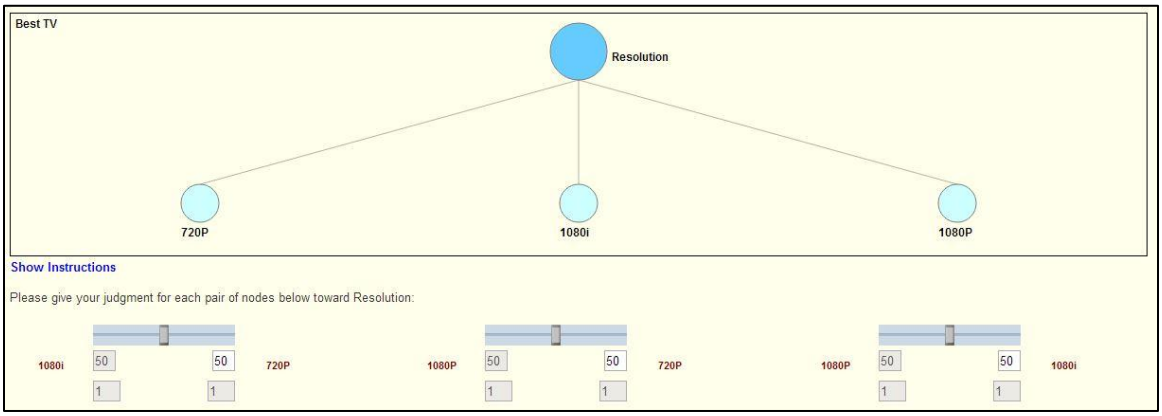


Figure 6: Level 3 – Resolution comparisons

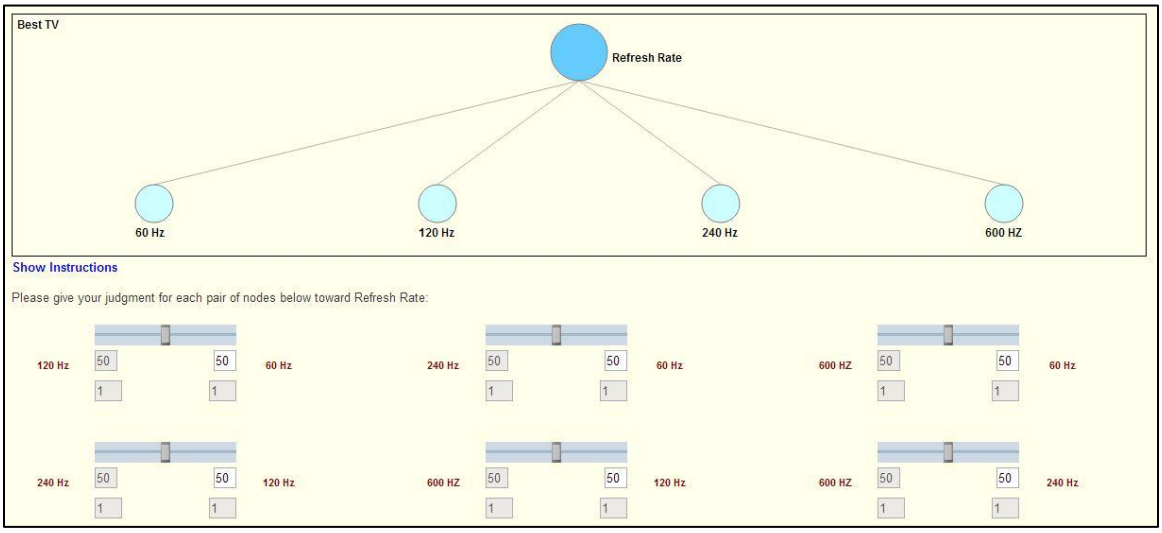


Figure 7: Level 3 – Refresh Rate comparisons

Model Results

Best HDTV For an Individual	Inconsistency
Philip Bottjen	0.04
Leopoldo Marino	0.01
Noppadon Vannaprapa	0.01
Rodney Danskin	0.04
Thanaporn Ngarmnil	0.07
Disagreement	**0.04**

Table 4 Individual Consistency

Best HDTV For an Individual	Price					Screen Size			Resolution			Refresh Rate			
	$200 to $600	$600 to $1,000	$1,000 to $1,400	$1,400 to $1,800	$1,800 to $2,200	30" to 40"	40" to 50"	50" to 60"	720p	1080i	1080p	60 Hz	120 Hz	240 Hz	600 HZ
Philip Bottjen	0.05	0.08	0.07	0.06	0.05	0.03	0.06	0.2	0	0.06	0.22	0	0.01	0.03	0.08
Leopoldo Marino	0.01	0.02	0.02	0.01	0.01	0.04	0.1	0.16	0.03	0.12	0.39	0.01	0.02	0.02	0.04
Noppadon Vannaprapa	0.06	0.14	0.09	0.08	0.06	0.07	0.13	0.05	0.03	0.06	0.15	0.01	0.01	0.04	0.03
Rodney Danskin	0.09	0.04	0.04	0.02	0.01	0.14	0.06	0.03	0.02	0.13	0.11	0.01	0.09	0.09	0.11
Thanaporn Ngarmnil	0.01	0.01	0.02	0.02	0.04	0.05	0.15	0.34	0.03	0.07	0.18	0.02	0.02	0.03	0.03
Mean	**0.04**	**0.06**	**0.05**	**0.04**	**0.03**	**0.07**	**0.1**	**0.16**	**0.02**	**0.09**	**0.21**	**0.01**	**0.03**	**0.04**	**0.06**
Minimum	**0.01**	**0.01**	**0.02**	**0.01**	**0.01**	**0.03**	**0.06**	**0.03**	**0.02**	**0.06**	**0.11**	**0.01**	**0.01**	**0.02**	**0.03**
Maximum	**0.09**	**0.14**	**0.09**	**0.08**	**0.06**	**0.14**	**0.15**	**0.34**	**0.03**	**0.13**	**0.39**	**0.02**	**0.09**	**0.09**	**0.11**
Std. Deviation	**0.03**	**0.05**	**0.03**	**0.03**	**0.02**	**0.04**	**0.04**	**0.11**	**0.01**	**0.03**	**0.1**	**0.01**	**0.03**	**0.02**	**0.03**

Table 5 Individual Weights

Source of Variation	Sum of Square	Deg. of freedom	Mean Square	F-test value
Between Subjects:	0.2	14	0.014	**4.77**
Between Conditions:	0	4	0	
Residual:	0.17	56	0.003	
Total:	**0.37**	**74**		
Critical F-value with degrees of freedom 14 & 56 at 0.01 level:				**2.42**
Critical F-value with degrees of freedom 14 & 56 at 0.025 level:				**2.11**
Critical F-value with degrees of freedom 14 & 56 at 0.05 level:				**1.87**
Critical F-value with degrees of freedom 14 & 56 at 0.1 level:				**1.63**

Table 6 F-Value Analysis

Individual Answers and results

Comparisons data provided by Bottjen Philip

Level-1: Contributions to Best HDTV For an Individual

Price:50 vs. Screen Size:50 | Price:52 vs. Resolution:48 | Price:72 vs. Refresh Rate:28

Screen Size:50 vs. Resolution:50 | Screen Size:72 vs. Refresh Rate:28

Resolution:72 vs. Refresh Rate:28

Level-2: Contributions to Price

$200 to $600:36 vs. $600 to $1,000:64 | $200 to $600:42 vs. $1,000 to $1,400:58 | $200 to $600:50 vs. $1,400 to $1,800:50 | $200 to $600:51 vs. $1,800 to $2,200:49

$600 to $1,000:50 vs. $1,000 to $1,400:50 | $600 to $1,000:64 vs. $1,400 to $1,800:36 | $600 to $1,000:58 vs. $1,800 to $2,200:42

$1,000 to $1,400:50 vs. $1,400 to $1,800:50 | $1,000 to $1,400:64 vs. $1,800 to $2,200:36

$1,400 to $1,800:58 vs. $1,800 to $2,200:42

Level-2: Contributions to Screen Size

30" to 40":22 vs. 40" to 50":78 | 30" to 40":21 vs. 50" to 60":79

40" to 50":13 vs. 50" to 60":87

Level-2: Contributions to Resolution

720P:13 vs. 1080i:87 | 720P:1 vs. 1080P:99

1080i:32 vs. 1080P:68

Level-2: Contributions to Refresh Rate

60 Hz:27 vs. 120 Hz:73 | 60 Hz:7 vs. 240 Hz:93 | 60 Hz:1 vs. 600 HZ:99

120 Hz:25 vs. 240 Hz:75 | 120 Hz:17 vs. 600 HZ:83

240 Hz:27 vs. 600 HZ:73

Expert's comments:

Figure 8: Comparison Data – Phillip Bottjen

Comparisons data provided by Leopoldo Marino

Level-1: Contributions to Best HDTV For an Individual

Price:25 vs. Screen Size:75 | Price:10 vs. Resolution:90 | Price:40 vs. Refresh Rate:60

Screen Size:40 vs. Resolution:60 | Screen Size:80 vs. Refresh Rate:20

Resolution:85 vs. Refresh Rate:15

Level-2: Contributions to Price

$200 to $600:40 vs. $600 to $1,000:60 | $200 to $600:35 vs. $1,000 to $1,400:65 | $200 to $600:55 vs. $1,400 to $1,800:45 | $200 to $600:40 vs. $1,800 to $2,200:60

$600 to $1,000:60 vs. $1,000 to $1,400:40 | $600 to $1,000:45 vs. $1,400 to $1,800:55 | $600 to $1,000:70 vs. $1,800 to $2,200:30

$1,000 to $1,400:60 vs. $1,400 to $1,800:40 | $1,000 to $1,400:65 vs. $1,800 to $2,200:35

$1,400 to $1,800:55 vs. $1,800 to $2,200:45

Level-2: Contributions to Screen Size

30" to 40":30 vs. 40" to 50":70 | 30" to 40":20 vs. 50" to 60":80

40" to 50":40 vs. 50" to 60":60

Level-2: Contributions to Resolution

720P:25 vs. 1080i:75 | 720P:5 vs. 1080P:95

1080i:30 vs. 1080P:70

Level-2: Contributions to Refresh Rate

60 Hz:40 vs. 120 Hz:60 | 60 Hz:35 vs. 240 Hz:65 | 60 Hz:30 vs. 600 HZ:70

120 Hz:40 vs. 240 Hz:60 | 120 Hz:37 vs. 600 HZ:63

240 Hz:36 vs. 600 HZ:64

Expert's comments:

Figure 9: Comparison Data – Leopoldo Marino

Comparisons data provided by Noppadon Vannaprapa

Level-1: Contributions to Best HDTV For an Individual

Price:67 vs. Screen Size:33 | Price:67 vs. Resolution:33 | Price:80 vs. Refresh Rate:20

Screen Size:50 vs. Resolution:50 | Screen Size:75 vs. Refresh Rate:25

Resolution:75 vs. Refresh Rate:25

Level-2: Contributions to Price

$200 to $600:40 vs. $600 to $1,000:60 | $200 to $600:50 vs. $1,000 to $1,400:50 | $200 to $600:40 vs. $1,400 to $1,800:60 | $200 to $600:33 vs. $1,800 to $2,200:67

$600 to $1,000:60 vs. $1,000 to $1,400:40 | $600 to $1,000:67 vs. $1,400 to $1,800:33 | $600 to $1,000:75 vs. $1,800 to $2,200:25

$1,000 to $1,400:60 vs. $1,400 to $1,800:40 | $1,000 to $1,400:67 vs. $1,800 to $2,200:33

$1,400 to $1,800:67 vs. $1,800 to $2,200:33

Level-2: Contributions to Screen Size

30" to 40":33 vs. 40" to 50":67 | 30" to 40":60 vs. 50" to 60":40

40" to 50":72 vs. 50" to 60":28

Level-2: Contributions to Resolution

720P:33 vs. 1080i:67 | 720P:20 vs. 1080P:80

1080i:25 vs. 1080P:75

Level-2: Contributions to Refresh Rate

60 Hz:33 vs. 120 Hz:67 | 60 Hz:20 vs. 240 Hz:80 | 60 Hz:22 vs. 600 HZ:78

120 Hz:25 vs. 240 Hz:75 | 120 Hz:30 vs. 600 HZ:70

240 Hz:67 vs. 600 HZ:33

Expert's comments:

Figure 10: Comparison Data – Noppadon Vannaprapa

Comparisons data provided by Rodney Danskin

Level-1: Contributions to Best HDTV For an Individual

Price:43 vs. Screen Size:57
Price:40 vs. Resolution:60
Price:44 vs. Refresh Rate:56
Screen Size:44 vs. Resolution:56
Screen Size:42 vs. Refresh Rate:58
Resolution:44 vs. Refresh Rate:56

Level-2: Contributions to Price

$200 to $600:75 vs. $600 to $1,000:25
$200 to $600:80 vs. $1,000 to $1,400:20
$200 to $600:85 vs. $1,400 to $1,800:15
$200 to $600:90 vs. $1,800 to $2,200:10
$600 to $1,000:75 vs. $1,000 to $1,400:25
$600 to $1,000:72 vs. $1,400 to $1,800:28
$600 to $1,000:71 vs. $1,800 to $2,200:29
$1,000 to $1,400:80 vs. $1,400 to $1,800:20
$1,000 to $1,400:93 vs. $1,800 to $2,200:7
$1,400 to $1,800:91 vs. $1,800 to $2,200:9

Level-2: Contributions to Screen Size

30" to 40":79 vs. 40" to 50":21
30" to 40":78 vs. 50" to 60":22
40" to 50":75 vs. 50" to 60":25

Level-2: Contributions to Resolution

720P:12 vs. 1080i:88
720P:22 vs. 1080P:78
1080i:47 vs. 1080P:53

Level-2: Contributions to Refresh Rate

60 Hz:14 vs. 120 Hz:86
60 Hz:15 vs. 240 Hz:85
60 Hz:11 vs. 600 HZ:89
120 Hz:47 vs. 240 Hz:53
120 Hz:46 vs. 600 HZ:54
240 Hz:48 vs. 600 HZ:52

Expert's comments:

Figure 11: Comparison Data – Rodney Danskin

Comparisons data provided by THANAPORN NGARMNIL

Level-1: Contributions to Best HDTV For an Individual

Price:9 vs. Screen Size:91
Price:19 vs. Resolution:81
Price:66 vs. Refresh Rate:34
Screen Size:75 vs. Resolution:25
Screen Size:74 vs. Refresh Rate:26
Resolution:76 vs. Refresh Rate:24

Level-2: Contributions to Price

$200 to $600:16 vs. $600 to $1,000:84
$200 to $600:21 vs. $1,000 to $1,400:79
$200 to $600:27 vs. $1,400 to $1,800:73
$200 to $600:22 vs. $1,800 to $2,200:78
$600 to $1,000:26 vs. $1,000 to $1,400:74
$600 to $1,000:26 vs. $1,400 to $1,800:74
$600 to $1,000:20 vs. $1,800 to $2,200:80
$1,000 to $1,400:25 vs. $1,400 to $1,800:75
$1,000 to $1,400:24 vs. $1,800 to $2,200:76
$1,400 to $1,800:21 vs. $1,800 to $2,200:79

Level-2: Contributions to Screen Size

30" to 40":14 vs. 40" to 50":86
30" to 40":21 vs. 50" to 60":79
40" to 50":17 vs. 50" to 60":83

Level-2: Contributions to Resolution

720P:21 vs. 1080i:79
720P:21 vs. 1080P:79
1080i:19 vs. 1080P:81

Level-2: Contributions to Refresh Rate

60 Hz:50 vs. 120 Hz:50
60 Hz:35 vs. 240 Hz:65
60 Hz:35 vs. 600 HZ:65
120 Hz:37 vs. 240 Hz:63
120 Hz:35 vs. 600 HZ:65
240 Hz:37 vs. 600 HZ:63

Expert's comments:

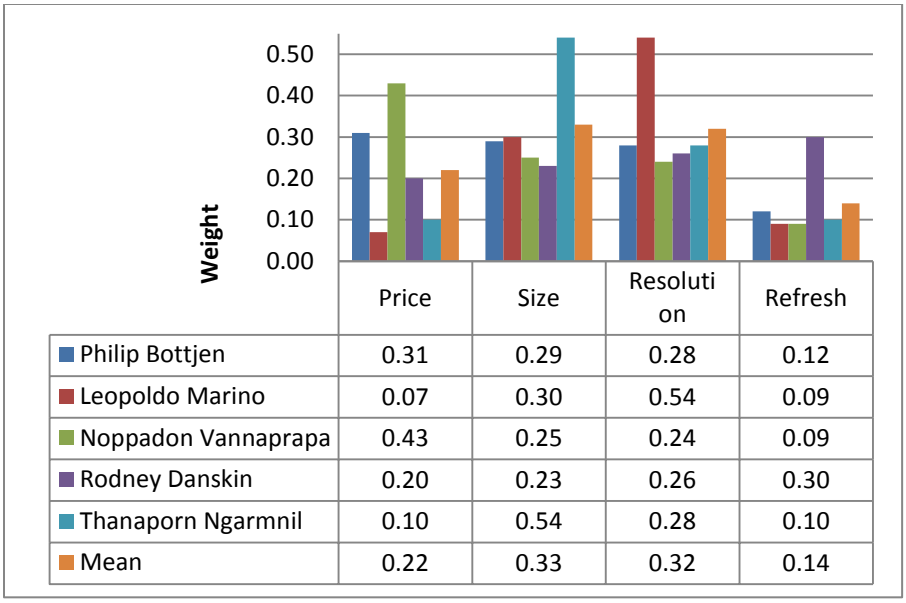
Figure 12: Comparison Data – Thanaporn Ngarmnil

Appendix B: PCM Results and Analysis

General Results and Analysis

Make	Model	Cost	Size (in.)	Resolution	Refresh Rate (hz)	Technology	Mean	Philip	Leopoldo	Noppadon	Rodney	Thanaporn
LG	32CS460	$279.00	32	720p	60	LCD	0.14	0.08	0.09	0.17	0.26	0.11
LG	37CS560	$399.00	37	720p	60	LCD	0.14	0.08	0.09	0.17	0.26	0.11
LG	42PM4700	$549.00	42	720p	600	Plasma	0.22	0.19	0.18	0.25	0.28	0.22
Samsung	PN43E450	$397.00	43	720p	600	Plasma	0.22	0.19	0.18	0.25	0.28	0.22
Panasonic	TH37PR11UK	$599.00	37	1080i	600	Plasma	0.26	0.22	0.21	0.22	**0.47**	0.16
Visio	E3D32OVX	$368.00	32	1080p	60	LCD	0.33	0.3	0.45	0.29	0.35	0.26
Samsung	UN32ES6500	$698.00	32	1080p	120	LED	0.37	0.34	0.47	0.37	0.38	0.26
Sony	46HX850	$2,072.00	46	1080p	240	LED	0.38	0.36	0.52	0.38	0.27	0.4
Samsung	UN40EH6000	$549.00	40	1080p	120	LED	0.38	0.34	0.52	0.35	0.35	0.36
Samsung	UN46EH6000	$599.00	46	1080p	120	LED	0.38	0.34	0.52	0.35	0.35	0.36
Panasonic	TC-L47ET5	$1,092.00	47	1080p	120	LED	0.39	0.36	0.53	0.38	0.3	0.37
Sony	KDL46HX750	$1,100.00	46	1080p	240	LED	0.40	0.38	0.53	0.41	0.3	0.38
LG	47LM6700	$949.00	47	1080p	120	LED	0.40	0.37	0.53	0.43	0.3	0.36
Panasonic	TC-L42E50	$699.00	42	1080p	120	LED	0.40	0.37	0.53	0.43	0.3	0.36
Panasonic	TC-L47E50	$832.00	47	1080p	120	LED	0.40	0.37	0.53	0.43	0.3	0.36
Toshiba	50L2200U	$599.00	50	1080p	60	LED	0.42	0.47	0.57	0.27	0.24	0.55
Panasonic	TC-P46X3	$695.00	46	1080p	600	Plasma	0.43	0.44	0.55	**0.45**	0.32	0.37
Sharp	LC52LE835U	$2,122.00	52	1080p	240	LED	0.44	0.5	0.58	0.3	0.24	**0.59**
Sony	KDL55HX750	$1,498.00	55	1080p	240	LED	0.45	0.51	0.58	0.32	0.25	0.57
Panasonic	TS-L55E50	$1,299.00	55	1080p	120	LCD	0.45	0.5	0.59	0.3	0.27	0.56
Panasonic	TC-L55ET5	$1,299.00	55	1080p	120	LED	0.45	0.5	0.59	0.3	0.27	0.56
Samsung	UN55EH6000	$799.00	55	1080p	120	LED	0.46	0.51	0.59	0.35	0.27	0.55
Panasonic	TC-P55ST50	$1,649.00	55	1080p	600	Plasma	0.47	0.56	0.6	0.31	0.27	0.57
Samsung	PN60E550	$1,297.00	60	1080p	600	Plasma	0.48	0.57	**0.61**	0.32	0.29	0.57
LG	50PA6500	$649.00	50	1080p	600	Plasma	**0.49**	**0.58**	**0.61**	0.37	0.29	0.56
LG	60PA5500	$949.00	60	1080p	600	Plasma	**0.49**	**0.58**	**0.61**	0.37	0.29	0.56
Samsung	PN51E550	$839.00	51	1080p	600	Plasma	**0.49**	**0.58**	**0.61**	0.37	0.29	0.56

Table 7 Results Analysis Worksheet



	Price	Size	Resolution	Refresh
Philip Bottjen	0.31	0.29	0.28	0.12
Leopoldo Marino	0.07	0.30	0.54	0.09
Noppadon Vannaprapa	0.43	0.25	0.24	0.09
Rodney Danskin	0.20	0.23	0.26	0.30
Thanaporn Ngarmnil	0.10	0.54	0.28	0.10
Mean	0.22	0.33	0.32	0.14

Figure 13: Comparison of Attributes

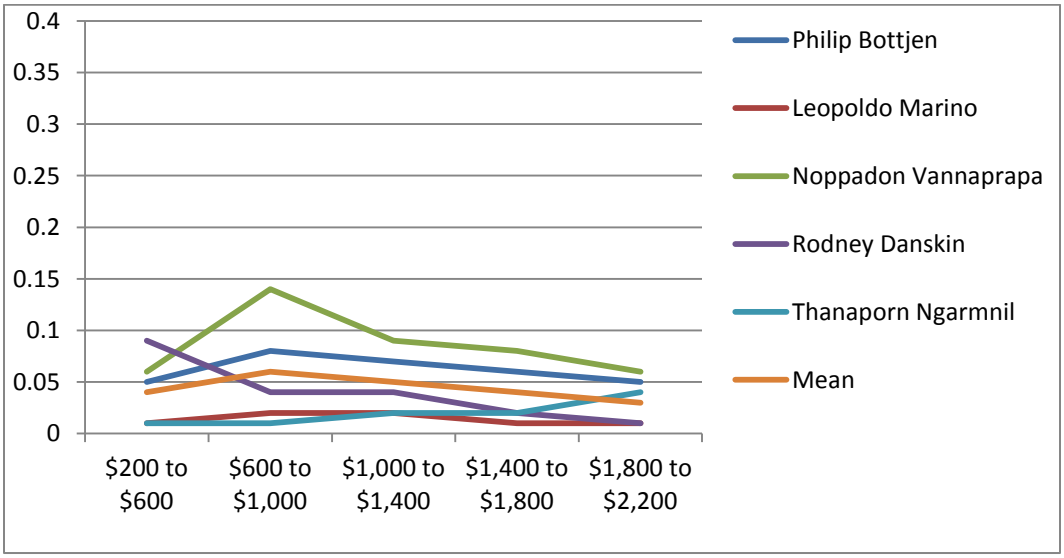


Figure 14: Comparison of Price

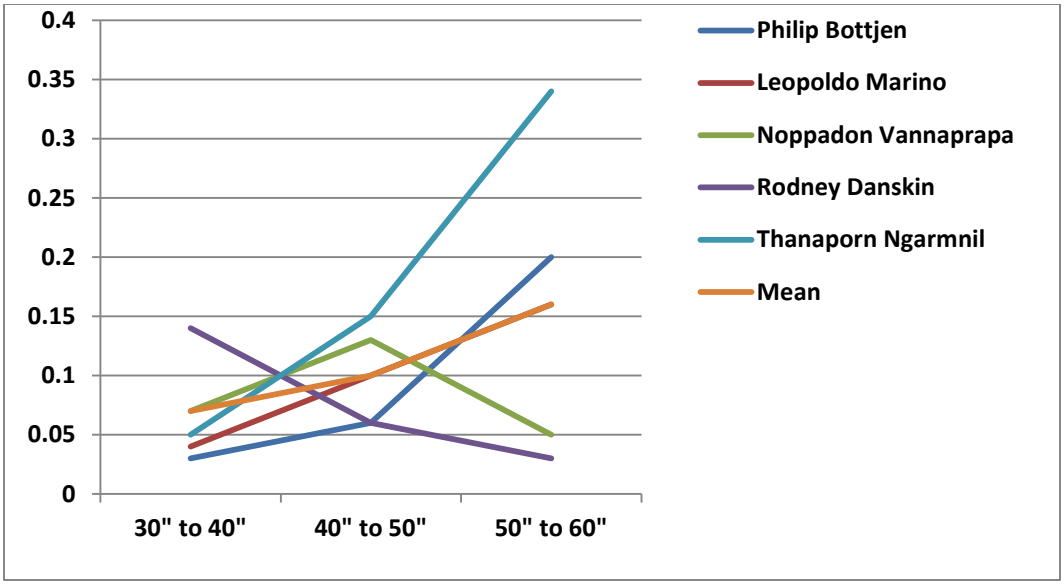


Figure 15 Comparison of Screen Size

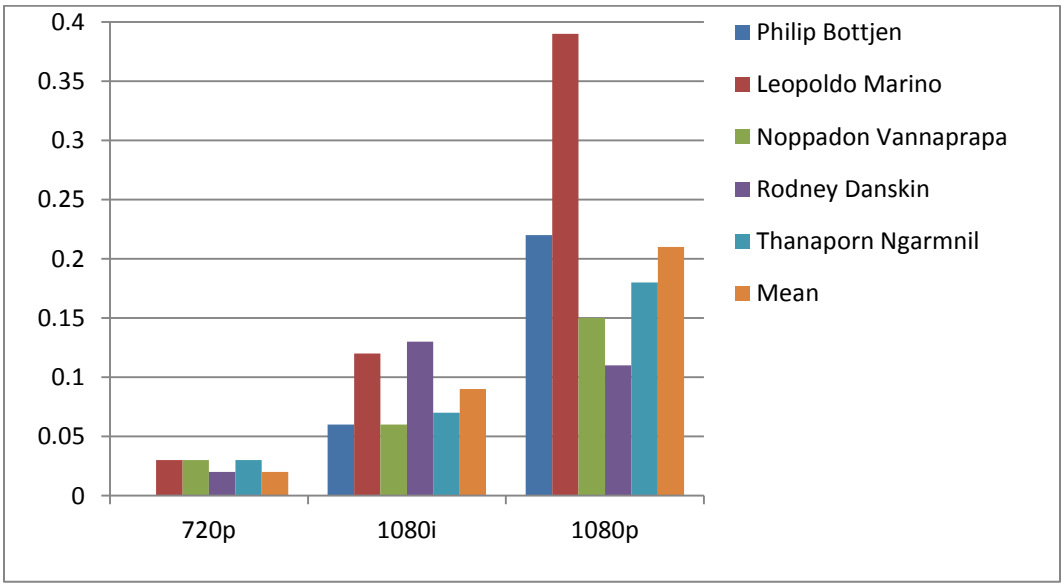


Figure 16: Comparison of Resolution

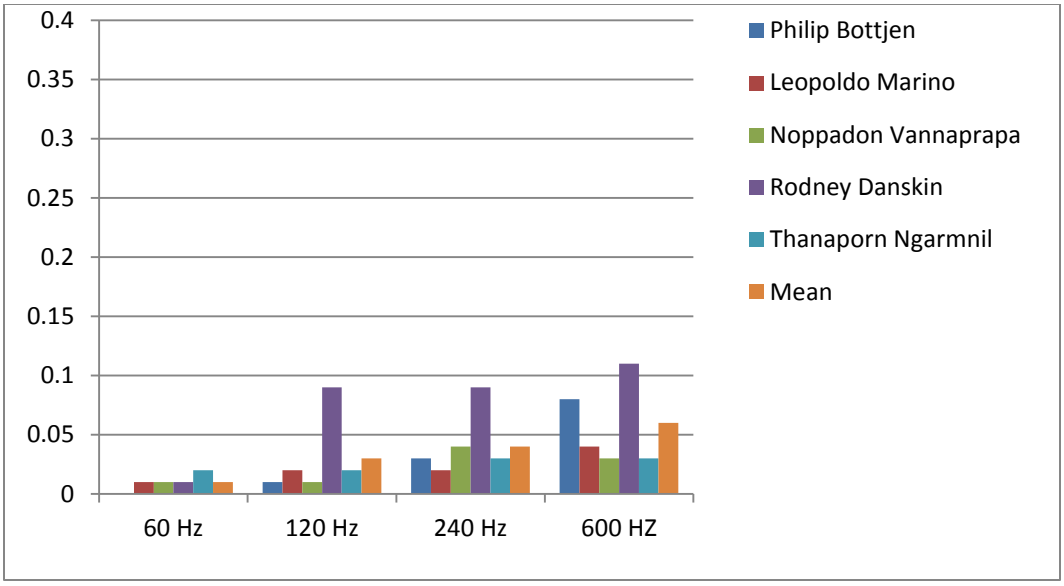
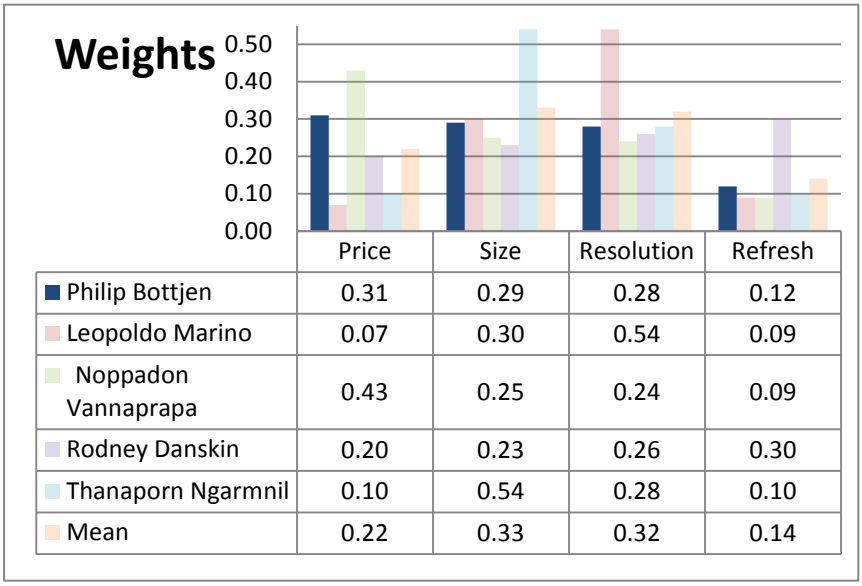
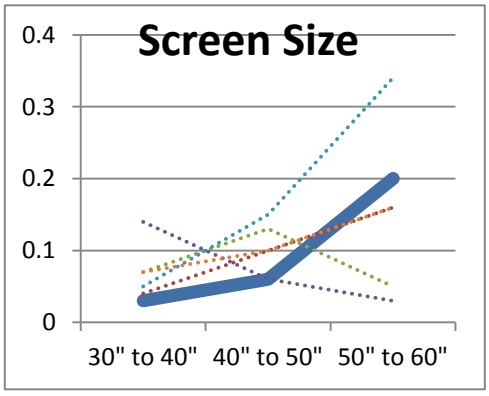


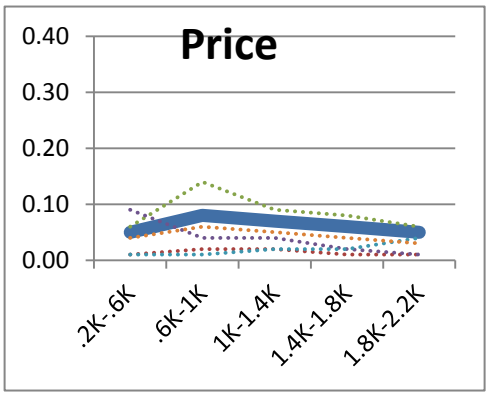
Figure 17: Comparison of Refresh Rate

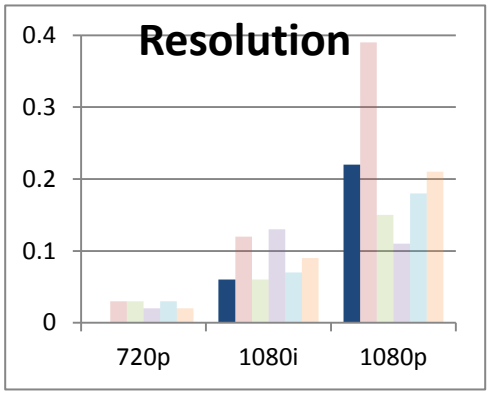
Individual Results



	Price	Size	Resolution	Refresh
Philip Bottjen	0.31	0.29	0.28	0.12
Leopoldo Marino	0.07	0.30	0.54	0.09
Noppadon Vannaprapa	0.43	0.25	0.24	0.09
Rodney Danskin	0.20	0.23	0.26	0.30
Thanaporn Ngarmnil	0.10	0.54	0.28	0.10
Mean	0.22	0.33	0.32	0.14







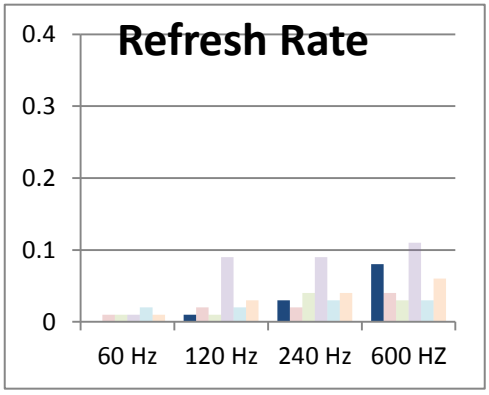
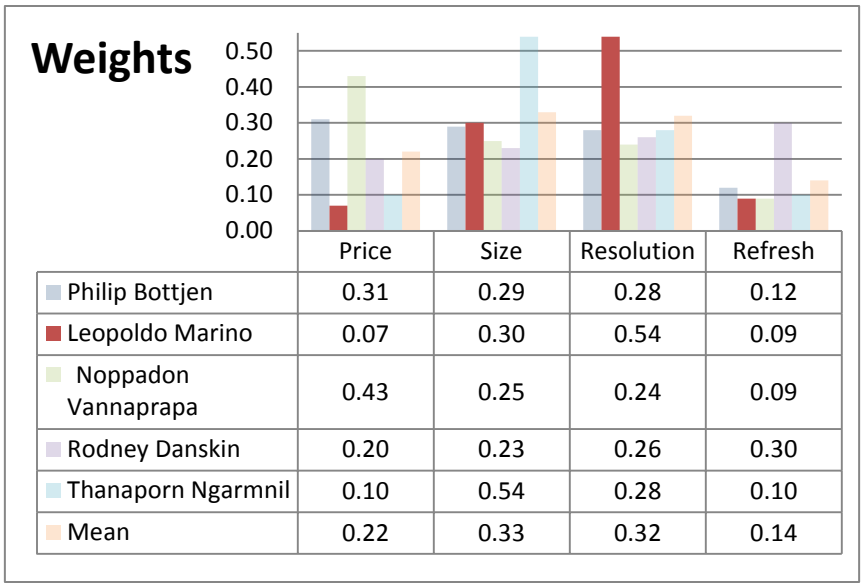
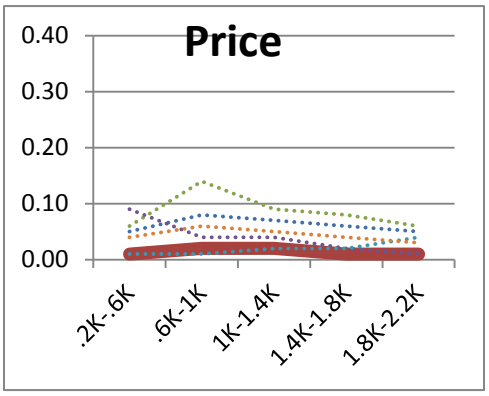
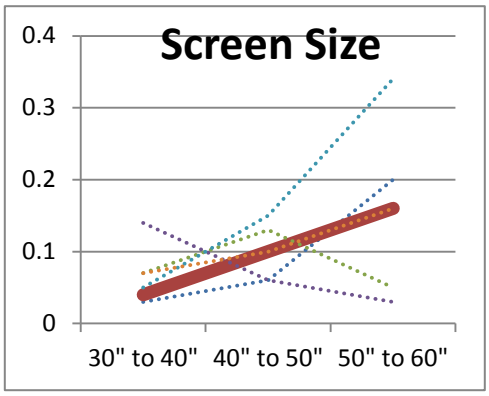


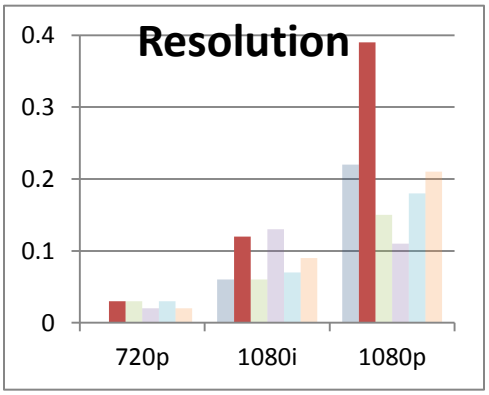
Figure 18: Result Analysis - Phillip Bottjen



	Price	Size	Resolution	Refresh
Philip Bottjen	0.31	0.29	0.28	0.12
Leopoldo Marino	0.07	0.30	0.54	0.09
Noppadon Vannaprapa	0.43	0.25	0.24	0.09
Rodney Danskin	0.20	0.23	0.26	0.30
Thanaporn Ngarmnil	0.10	0.54	0.28	0.10
Mean	0.22	0.33	0.32	0.14







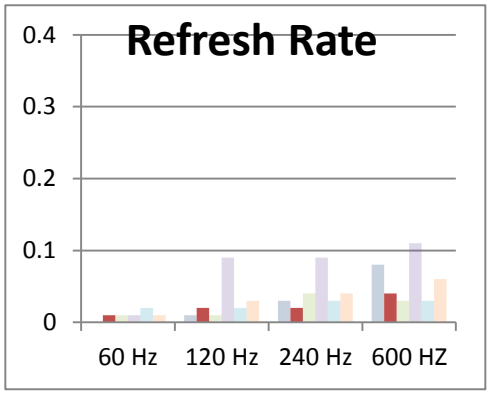
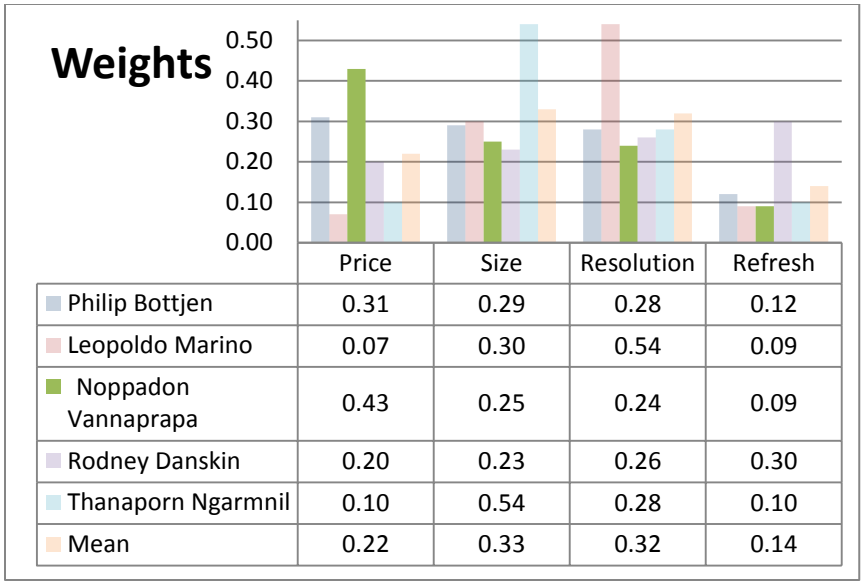


Figure 19: Result Analysis - Leopoldo Marino



	Price	Size	Resolution	Refresh
Philip Bottjen	0.31	0.29	0.28	0.12
Leopoldo Marino	0.07	0.30	0.54	0.09
Noppadon Vannaprapa	0.43	0.25	0.24	0.09
Rodney Danskin	0.20	0.23	0.26	0.30
Thanaporn Ngarmnil	0.10	0.54	0.28	0.10
Mean	0.22	0.33	0.32	0.14

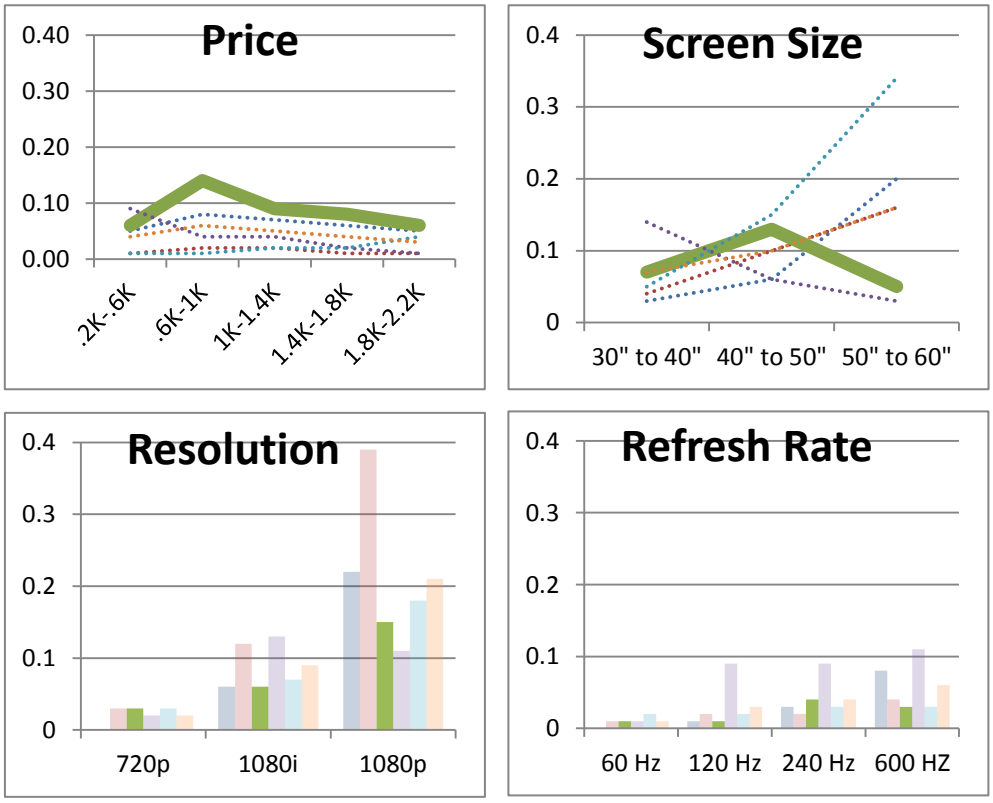
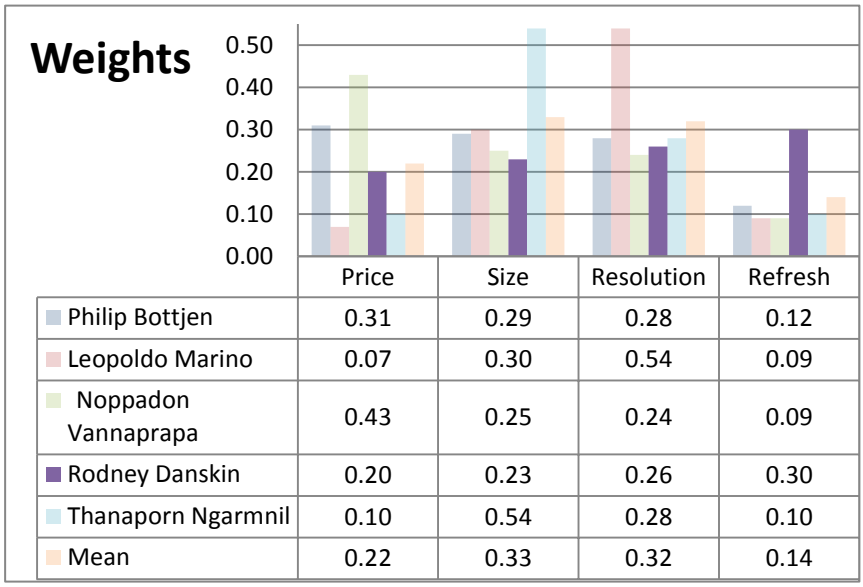
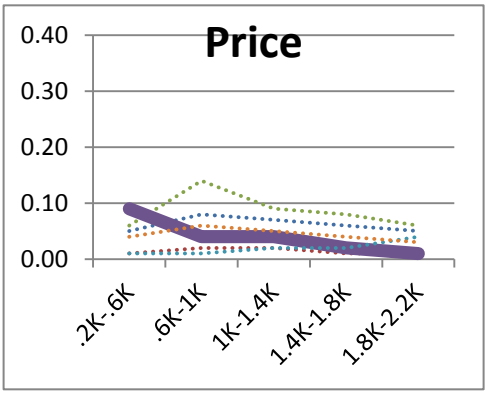
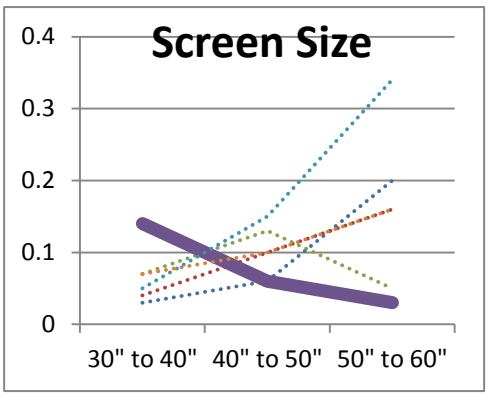


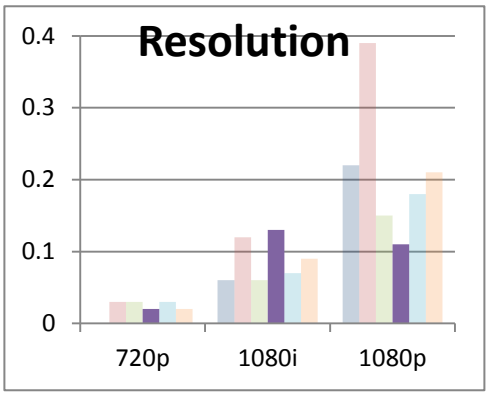
Figure 20: Result Analysis - Noppadon Vannaprapa



	Price	Size	Resolution	Refresh
Philip Bottjen	0.31	0.29	0.28	0.12
Leopoldo Marino	0.07	0.30	0.54	0.09
Noppadon Vannaprapa	0.43	0.25	0.24	0.09
Rodney Danskin	0.20	0.23	0.26	0.30
Thanaporn Ngarmnil	0.10	0.54	0.28	0.10
Mean	0.22	0.33	0.32	0.14







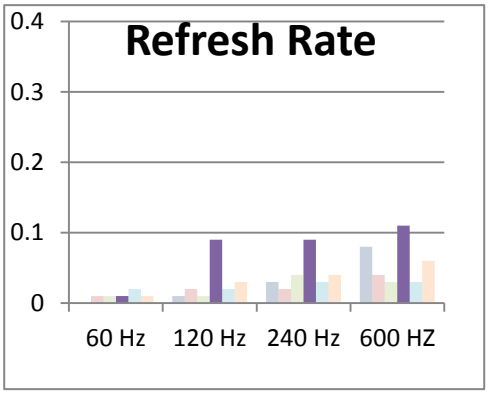


Figure 21: Result Analysis - Rodney Danskin

	Price	Size	Resolution	Refresh
Philip Bottjen	0.31	0.29	0.28	0.12
Leopoldo Marino	0.07	0.30	0.54	0.09
Noppadon Vannaprapa	0.43	0.25	0.24	0.09
Rodney Danskin	0.20	0.23	0.26	0.30
Thanaporn Ngarmnil	0.10	0.54	0.28	0.10
Mean	0.22	0.33	0.32	0.14

Figure 22: Result Analysis - Thanaporn Ngarmnil

Appendix C: List of Figures and Tables

Figures

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