# Statistical Analysis of Human Factor Studies of Graphical User Interface Components

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Submitted to the Department of Electrical Engineering and Computer Science and the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Science

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# Acknowledgments

First of all, I would like to thank my advisor Dr. Arvin Agah for giving me an opportunity to work under him, and for his guidance and support throughout this thesis and beyond. I would also like to thank Dr. Susan Gauch and Dr. Jerry James for being on my thesis committee.

I would also like to thank Dr. John Kelly for his advise on how to construct a hypothesis and validate it using ANOVA. I express my gratitude to Dr. Lynn Watney of Kansas Geological Survey who provided all the facilities to carry out the experiments. Lastly, I am grateful to all the volunteer subjects who gave their time to help me with the experiments.

# Abstract

With the World Wide Web becoming so pervasive, the usage of graphical user interface components in various online applications has become very common. The purpose of this study was to examine the effect of information presentation and query navigation on user response on graphical user interfaces such as html forms. The variables evaluated were the number of clicks and time taken by each human subject to complete a set of forms. Statistical analysis was carried out to examine the most effective form of query display and navigation.

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# Chapter 1

# Introduction

With the rapid development and expansion of the Internet one is able to access information from sources all over the world. From car insurance to pizza pickup everything can be done online. Forms are ubiquitous from dental checkups to filing tax returns. In order to make the user experience pleasant, forms graphical user components must be designed carefully. Forms come in many flavors from one-page radio button questions to multiple pages with tab navigation and drop down list questions. This study looks at various ways questions in forms can be presented and navigated.

## 1.1    Approach

In this study, human subjects participating in the experiment were asked to complete three forms. Each form had 14 questions. The topics of the forms were credit, health and vacation. The forms were designed such that the users could select only one answer to each question. Each form was unique in the way it displayed the questions and in its allowed navigation. The time taken to fill up each form along with the number of mouse clicks were recorded. In each form, questions were displayed either as radio buttons, as drop down lists, or as list boxes. Three common navigation mechanisms were studied, namely tabs, single page and the next/previous type of navigation. The study involved a statistical analysis of the collected results.

## 1.2    Thesis Organization

This thesis is organized into five chapters. Chapter 2 provides a background of statistical analysis. Screen shots of the question display and the navigation types are shown in this chapter. Chapter 3 discusses design and implementation of the experiments in detail. All the graphs along with results from the analysis are presented in Chapter 4. Finally, in Chapter 5, conclusions are presented based on the results from the experiments and possible future work is suggested.

# Chapter 2

# Background

In this chapter all the statistical background required to perform an effective data analysis is described. This chapter focuses on analysis of variance, a method developed by R.A. Fischer [7]. Analysis of variance is used to measure the differences among means. The "analysis of variance" is abbreviated as ANOVA. The formulation of a hypothesis and its effective validation is also explained in this chapter. The latter half of the chapter describes in detail the various graphical user interface components used in this study along with their screen shots.

## 2.1 ANOVA

Figure 2.1 shows data arranged for sample analysis of variance. Samples are classified into *groups*, sometimes called *classes*.



**Figure 2.1 Data Arranged for ANOVA.**

In any ANOVA we have two or more such groups or classes of samples, and the symbol $a$ represents the number of groups. Each group or sample is based on $n$ items. $\Sigma^{n}Y$ indicates the sum of items of a single group and $\Sigma^{an}Y$ indicates the sum of all items of all groups. The variance of the data can be estimated in two ways. The first estimate of the variance is called variance within groups. The variance within groups is computed as :

$$\frac{1}{a(n-1)} \sum_{i=1}^{a}\sum_{j=1}^{n} (Y_{ij} - \bar{Y}_i)^2$$

The double summation means that we start with the first group and then we sum the squared deviations of all items from the mean of the first group, by changing the index of j in the inner summation. This process is continued till the outer index is set to $a$, which is the total number of groups.

The variance among groups is computed as :

$$\frac{n}{a-1} \sum_{i=1}^{i=a} (\bar{Y}_i - \bar{\bar{Y}})^2$$

First $\bar{\bar{Y}}$ is computed, which is the grand mean of the group means. The sum of squares, $(\bar{Y}_i - \bar{\bar{Y}})^2$ represents deviations of the group means from the grand mean. We divide it by $a-1$, because the sum of squares was based on $a$ items.

Now we have two estimates for the variance of our data. A statistical test is required to test the hypothesis that they estimate the same parameter. Such a test employs the F-distribution [8], which is discussed in detail in the next section.

## 2.2   F- Distribution

If we are sampling at random from a normally distributed population, with mean $\mu$ and variance $\sigma^2$ and the sampling procedure consists of first sampling $n_1$ items and calculating their variance $s_1^2$, followed by sampling $n_2$ items and calculating $s_2^2$. The degrees of freedom of the two variances are $v_1 = n_1-1$ and $v_2 = n_2-1$ respectively. Sample sizes $n_1$ and $n_2$ need not be equal. After obtaining $s_1^2$ and $s_2^2$ we can calculate

$$Fs = \frac{S_1^2}{S_2^2}$$

This ratio will be close to 1, if these variances are estimates of the same quantity. Its value depends upon the relative magnitudes of variances $s_1^2$ and $s_2^2$. Statisticians have worked out the expected distribution of this statistic, which is called the F-distribution. F distributions of 4 and 12 degrees of freedom, and 10 and 100 degrees of freedom are shown below in Figure 2.2.
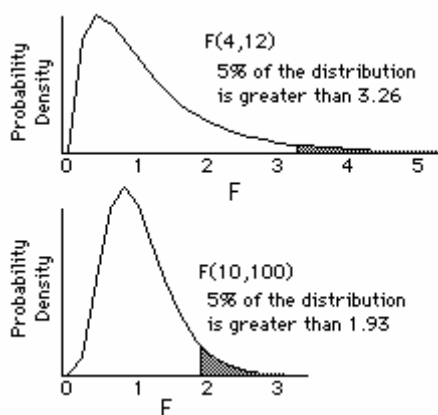


**Figure 2.2: F-Distribution.**

The first graph of Figure 2.2 [9] is a one-tailed 5% rejection, marked off at F = 3.26. The second graph has a rejection value marked at F = 1.93, this is due to the fact that the F-distribution changes with the degrees of freedom in the numerator and the denominator.

## 2.2    Hypothesis Testing and p-Value

As we saw in section 2.1 the total sum of squares and degrees of freedom can be partitioned additively into those of variation among groups and those of variation within groups. To summarize they are

$$SS_{among} = \frac{n}{a-1} \sum_{i=1}^{a} (\bar{Y_i} - \bar{\bar{Y}})^2$$

$$SS_{within} = \frac{1}{a(n-1)} \sum_{i=1}^{a}\sum_{j=1}^{n} (Y_{ij} - \bar{Y_i})^2$$

Since we have two estimates for the variance, we take the ratio $\frac{SSamong}{SSwithin}$

and compare it to the standard F-distribution with the appropriate degrees of freedom. The null hypothesis as applied to most cases in this document is that the group means are the same, i.e.,

$$\mu_{Group1} = \mu_{Group2} = \mu_{Group3} = \ldots = \ldots = \ldots = \ldots = \mu_{Groupn}$$

We can make a decision to reject the null hypothesis if the value of the test statistic falls in the rejection region. An alternative way to make a decision is to calculate the p-value, or observed significance level. The p-value is the probability of obtaining a value of the test statistic as extreme as that which is observed assuming the null hypothesis is true. If the p-value corresponding to the F-value is less then 0.05, then the null hypothesis is

rejected, indicating that the means of the groups are not the same [10]. If the p-value is greater than 0.05, then the null hypothesis is accepted.

## 2.4 ANOVA with Two Groups

A frequent test in statistics is to establish the significance of the difference between two means, which can be done easily by using ANOVA for two groups. However, there is another popular method called the t-test [11]. The t-test has no real advantage over ANOVA when applied to hypothesis testing; it is mathematically equivalent to an ANOVA. The t-test is very useful in applying confidence limits on the difference between the two means. Another validation of the null hypothesis is that the 95% confidence limits contain the zero point (no difference), if the difference's between the means of groups is not significant.

## 2.5 Factorial ANOVA

Often more than one factor affects a response variable. A factorial analysis of variance can be used to analyze the effect of two or more factors [12]. The analysis of variance for a two-factor experiment is an extension of the analysis of variance for a single factor experiment. The analysis evaluates the effects of the two factors, called main effects, and the joint effects of the two factors, called interactions [13]. The two factors interact if the effect of one factor on the response depends on the level of the other factor. In our experiments the time or the number of clicks represents the response while the type of navigation and the type of question display constitute the two factors.

## 2.6  Graphical User Interface Components

The main objective of this thesis is to study the effect of various graphical user interface components on user responses. The following sections explain in detail the various types of question display and navigation components used in this study. Screen shots of some of the components are also included.

## 2.7  Question Display

There are various methods of displaying questions on online forms. Three types of question displays were used in the experiments that were performed.

### 2.7.1  Radio Button

Radio Buttons are a popular form of question display.  The user can select an answer of his or her answer by clicking on the appropriate choice. A screen shot of a radio button display used in the experiments is shown Figure 2.3. Only one item can be selected among the radio buttons.
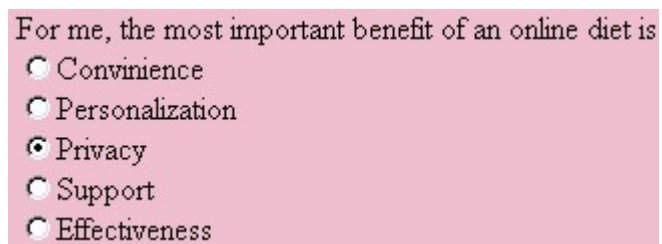


**Figure 2.3: Screen Shot of Radio Button.**

### 2.7.2  List Box

Another popular way of displaying choices is the List Box. All the choices are shown to the user without any scroll bar. Figure 2.4 shows a screen shot of a list box.



**Figure 2.4: Screen Shot of List Box.**

### 2.7.3  Drop Down List

Drop Down Lists are widely used to display choices to user. The user has to scroll in order to view all the choices and to make an appropriate selection. A screen shot of a Drop Down List is shown in Figure 2.5.
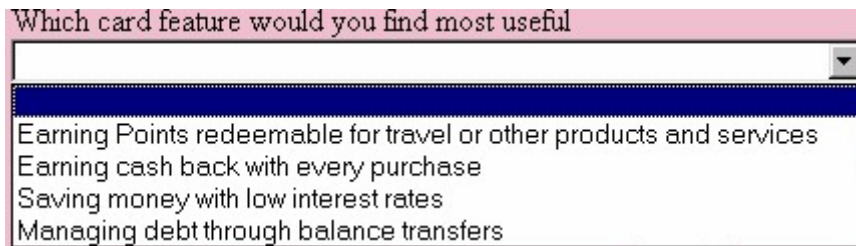


**Figure 2.5: Screen Shot of Drop Down List.**

## 2.8    Type of Navigation

Three types of form navigation were used in the experiments. They were Single Page, Next/Previous and Tab Navigation.

### 2.8.1 Single Page

In the single page type of navigation all the questions are displayed on one page irrespective of the questionnaire size. The subjects answered all the questions, 14 of them, and submitted the form.

### 2.8.2 Next/Previous Navigation

This type of navigation is commonly used on online forms. The user navigates between pages through the next/previous link found at the bottom of each page. Figure 2.6 shows a screen shot of this type of navigation.



**Figure 2.6 Screen Shot of Next/Previous Navigation.**

### 2.8.3 Tab Navigation

Another popular style of navigation is tab navigation. Navigation between forms can be done using the tabs at the top of every form. A screen shot of tab navigation is shown in Figure 2.7.
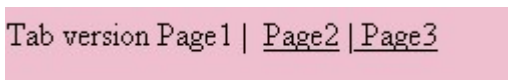


**Figure 2.7 Screen Shot of Tab Navigation.**

## 2.9    Related Work

Researchers have studied navigation with respect to hyperlinks and others have studied graphical user interface components with respect to individual differences and for people with disabilities. None of these works have studied graphical user interface components in the context of forms.

Panayiotis Zaphris (2000) did an experiment to look at different ways in which links can be arranged [1]. Subjects participating in this experiment were asked to complete tasks. Time to complete those tasks depended on the way links were arranged on a web page.

Curl and Olfman (1998) did a study to understand to what extent leveraging the graphical user interface's ability to convey spatial information can improve a user's ability to write effective database queries [3]. One hundred and sixty-two volunteers participated in the study, which proved that both spatial visualization support of the system and spatial visualization ability of the user are important components.

Kiger (1984) did an experiment that gave users five modes of varying menu design. The menus were indexes to a database. Subjects participating in the experiment were asked to find some piece of information in the database, and then to answer a questionnaire regarding the experiment. The results of the experiment showed that the time and the number of errors increased with the depth of the menu structure. The participants ranked the menus with greater depth as the least favorable.

# Chapter 3

# Experiment

## 3.1  Hypothesis

The design of this study is to test the following hypothesis:

The time, number of mouse clicks and complexity of filling an online form is directly related to the way questions are displayed and what kind of navigation are provided. The two variables, i.e. time and number of mouse clicks will vary based on the design of the forms.

In this chapter implementation of the experimental setup is described in detail. All of the forms were generated dynamically using Java servlets. The bulk of the implementation was done using Java. Javascript was incorporated on the client side for validation.

## 3.2  Human Subjects

A total of 27 human subjects participated in the study, comprised of 6 women and 21 men. The subject's ages ranged from 22 to 55. Many of the subjects were associated with a university. All of the subjects had some knowledge of the Internet and had experience filling online forms.

## 3.3    Procedure

Each subject in the study was presented with an introductory web page, which had the instruction on how to go about the experiment. After the introduction page once the subject clicked on the first form, the first of the three forms was displayed. All distractions were avoided during the experiment.

Each subject was presented with three forms and every form had 14 questions. More than 10 questions were needed so that the forms could have the option of navigation. The sequence chart in Figure 3.1 summarizes the experimental set up. Each experiment was done with three types of question display and three types of navigation and three type of questionnaire, hence there were 27 possible cases. The chart describes one of the 27 possible cases. Questions for the three type of questionnaire was collected from various websites of interest. The selected questions were easy to understand and were believed to be of the same difficulty.
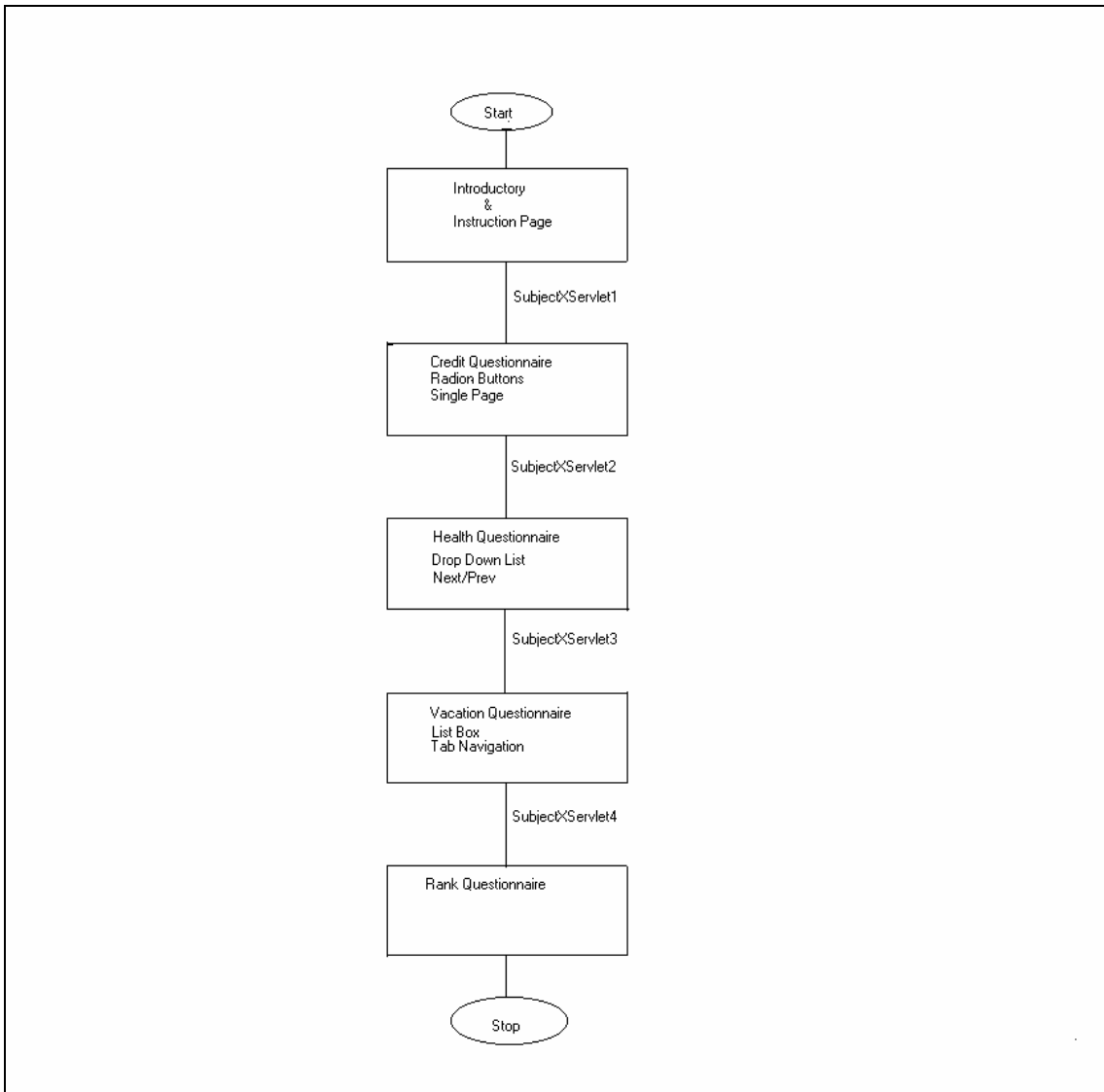
**Figure 3.1 Flow chart of the experimental setup with a test scenario.**

As subjects filled these forms, their answers were recorded along with the time and the number of clicks required to complete each form. At the end of the experiment, each subject was given a rank questionnaire to fill out. On the questionnaire they had the opportunity to rank the forms on a scale of one to five. Also they were asked about the number of online forms they had filled out so far.

## 3.4    Sequence Screenshots

This section lists all the screenshots of the scenario described in the flow chart of Figure 3.1. Figure 3.2 shows the screen shot of the introductory page. Each subject was presented with this page at the start of the experiment.
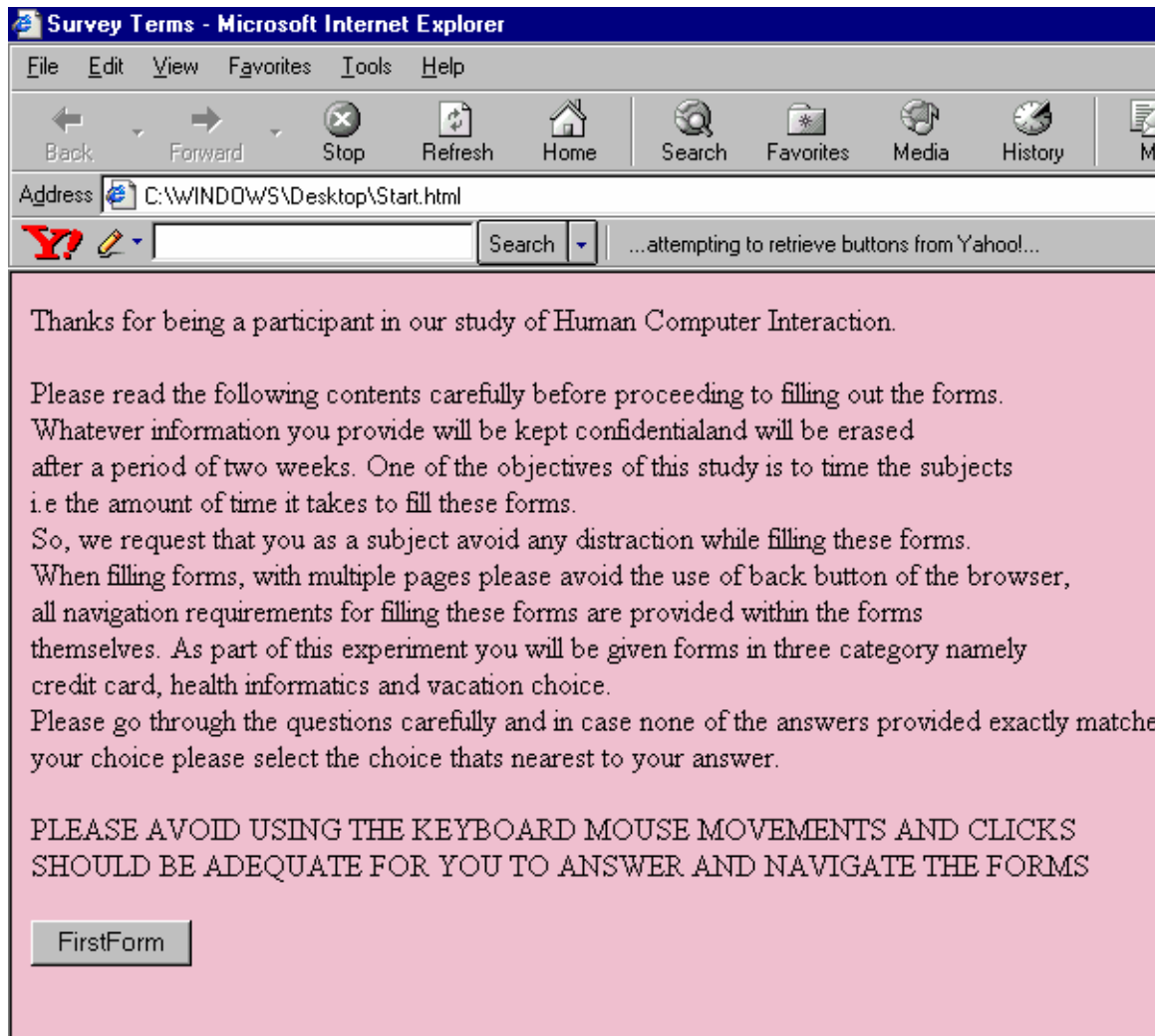


**Figure 3.2 Screen shot of introductory and instruction page.**

On clicking the first form button, the subject was presented with the page as shown in Figure 3.3.
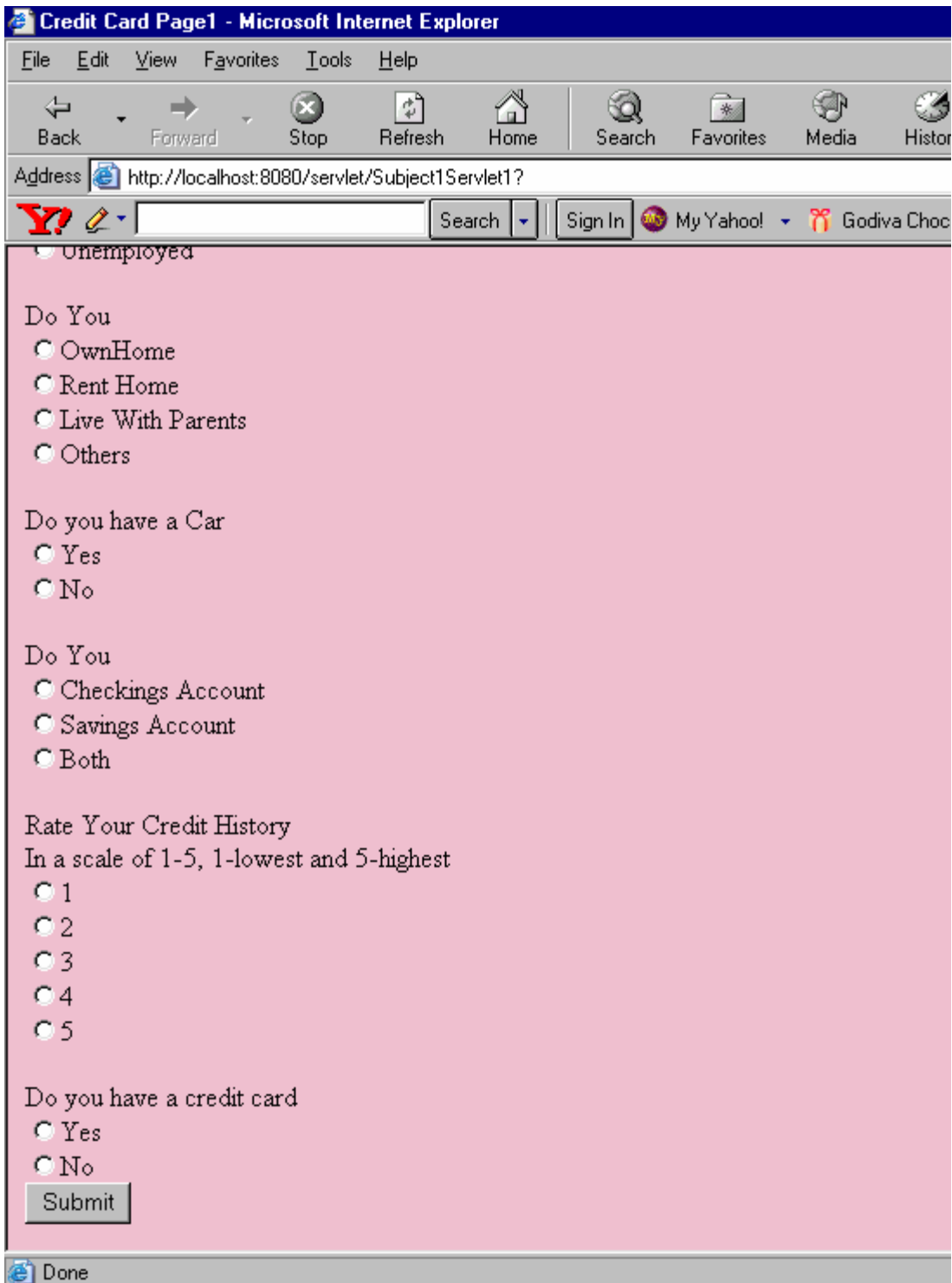
**Figure 3.3 Credit questionnaire with radio button and single page submission.**

Once the subject clicks the submit button the form is submitted if and only if all the questions have been answered. The timer stops once the subject submits the form. The

second form is generated once the subject clicks the second form button as shown in Figure 3.4
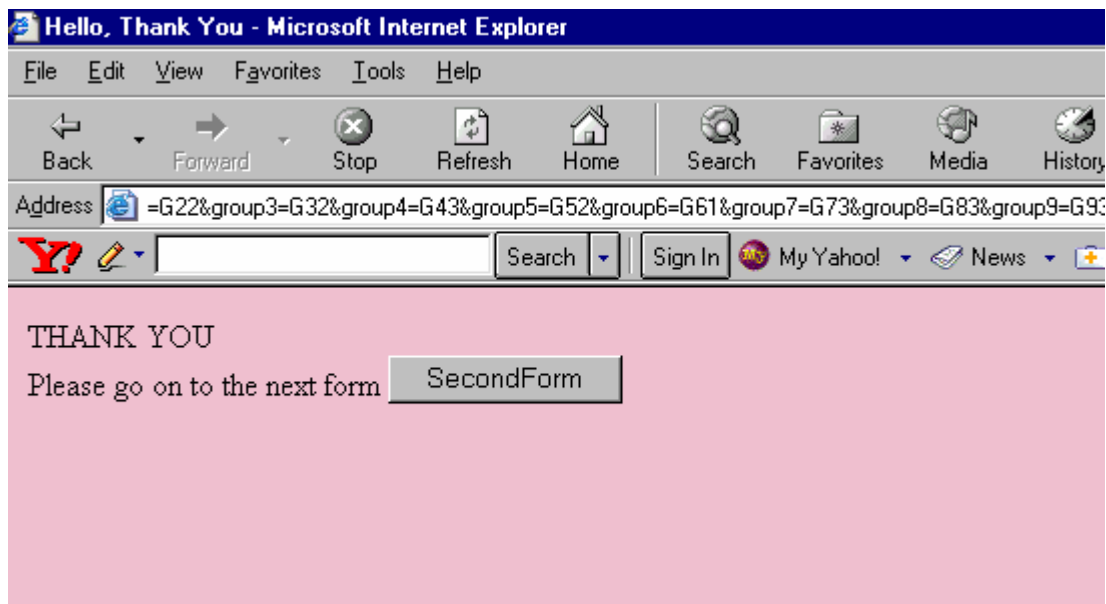


**Figure 3.4 Screen shot of page prior to second form.**

The second form in this example scenario is a health questionnaire with a drop down list and next/previous navigation. The screen shots of this form are shown in Figures 3.5, 3.6 and 3.7.
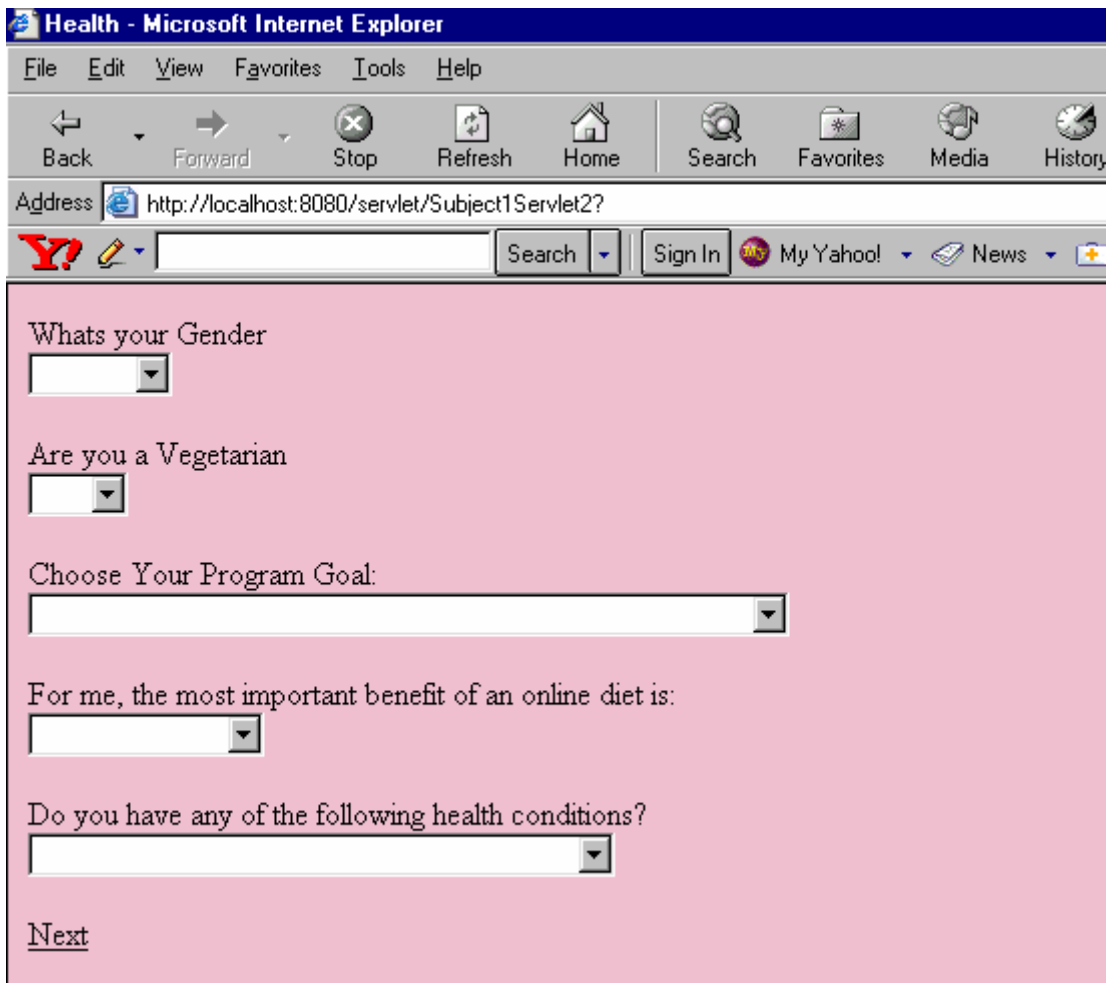
**Figure 3.5 Health questionnaire with drop down list and next/previous navigation Page 1.**
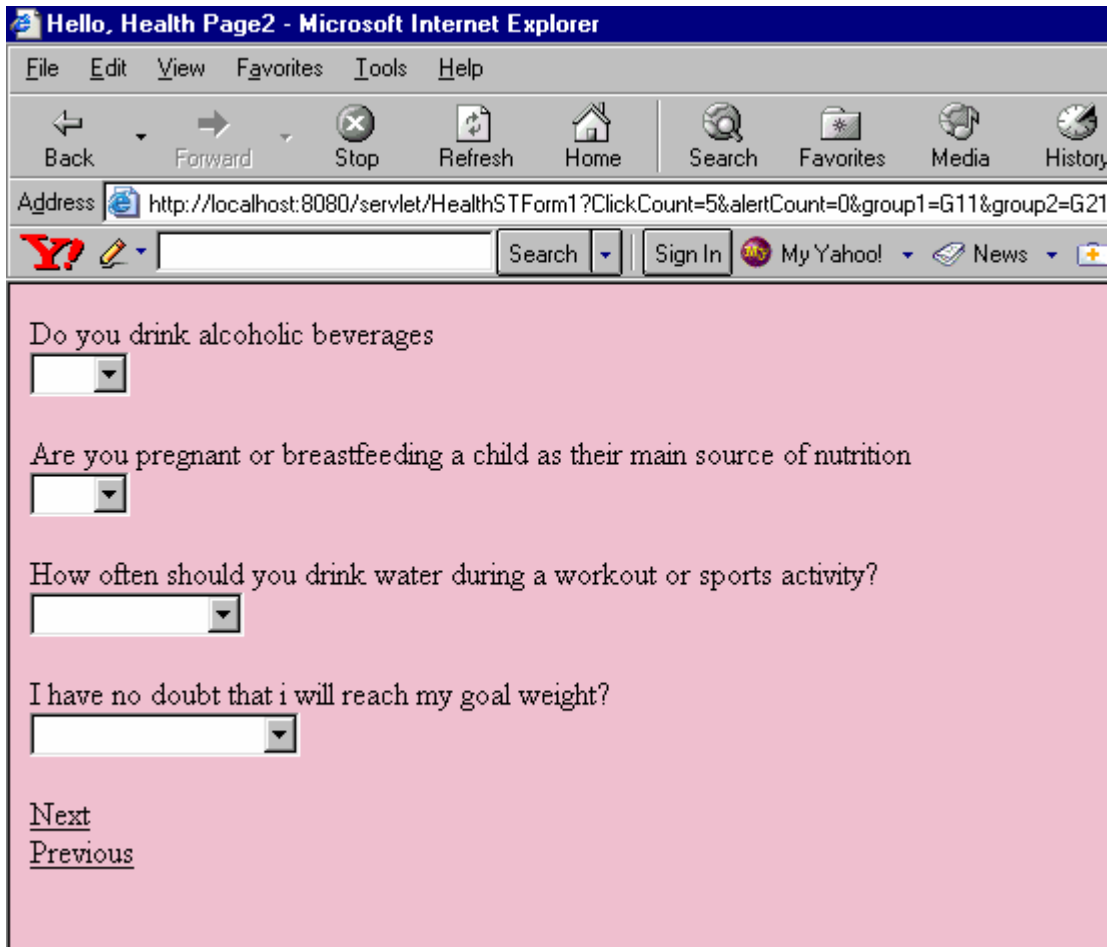
**Figure 3.6 Health questionnaire with drop down list and next/previous navigation Page 2.**
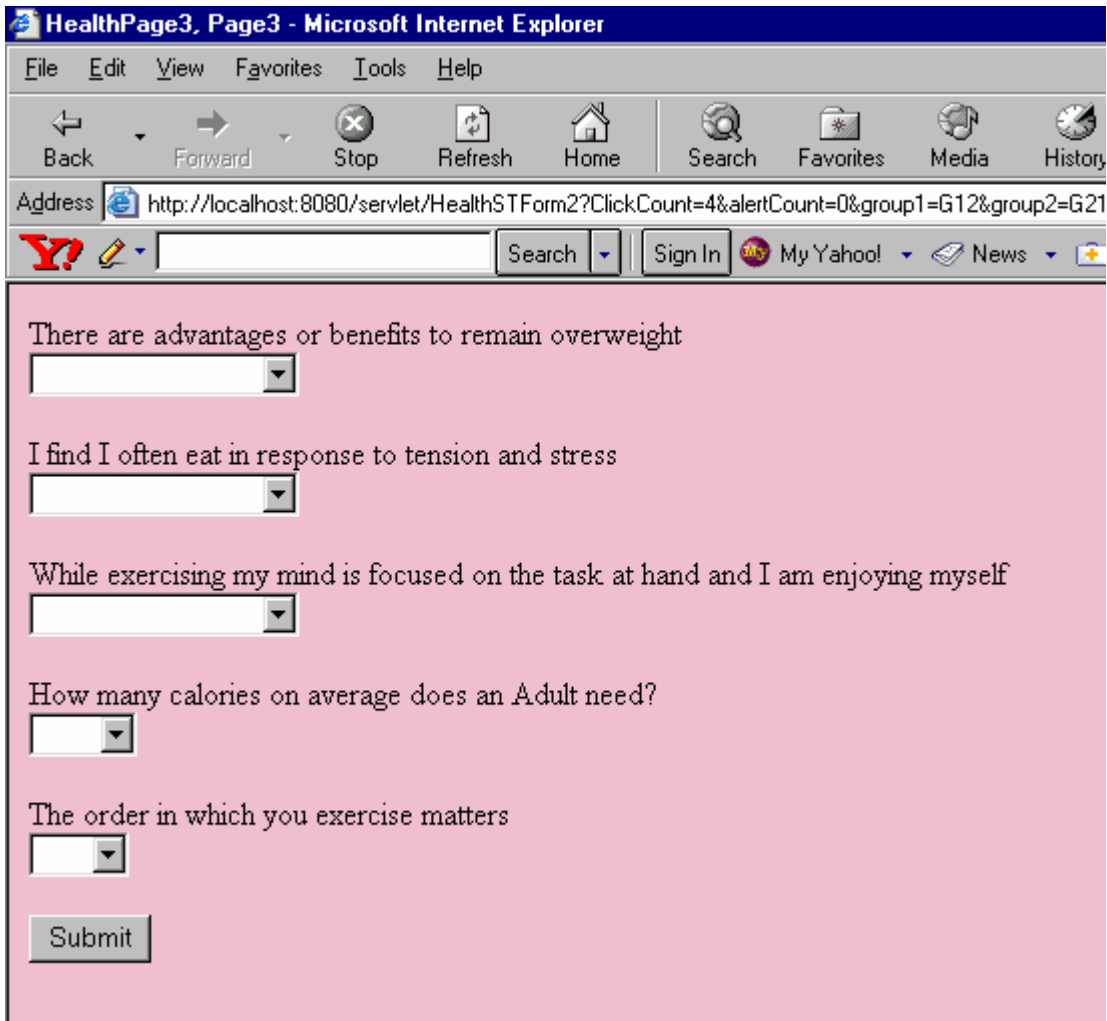
**Figure 3.7 Health questionnaire with drop down list and next/previous navigation Page 3.**

When the subject clicks the submit button the form is submitted and the time and the number of clicks are recorded. The page as shown in Figure 3.8 pops up prompting the user to continue to the third form.
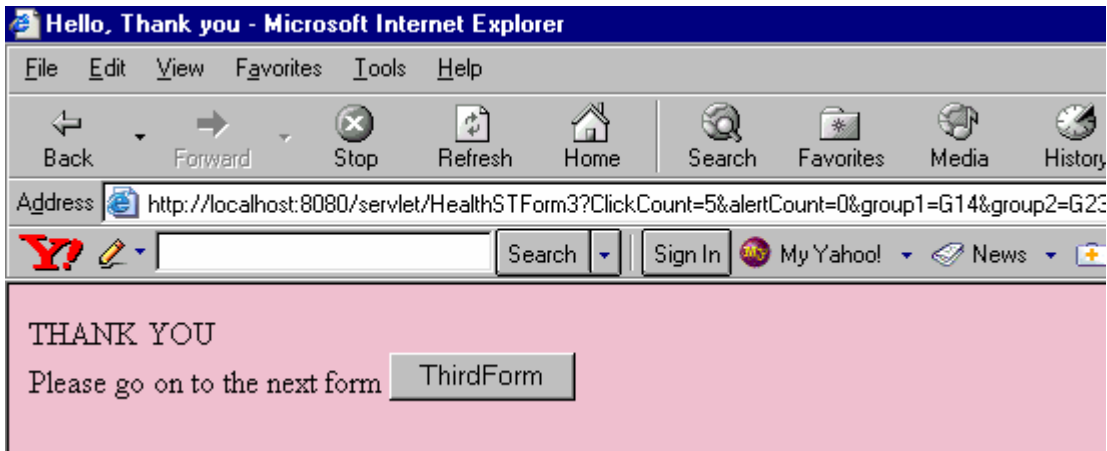
**Figure 3.8 Screen shot of page prior to the third form.**

Once the subject clicks the third form button, a vacation questionnaire form with a list box and tab navigation is presented. The three pages that make up this form are shown in Figures 3.9, 3.10 and 3.11.
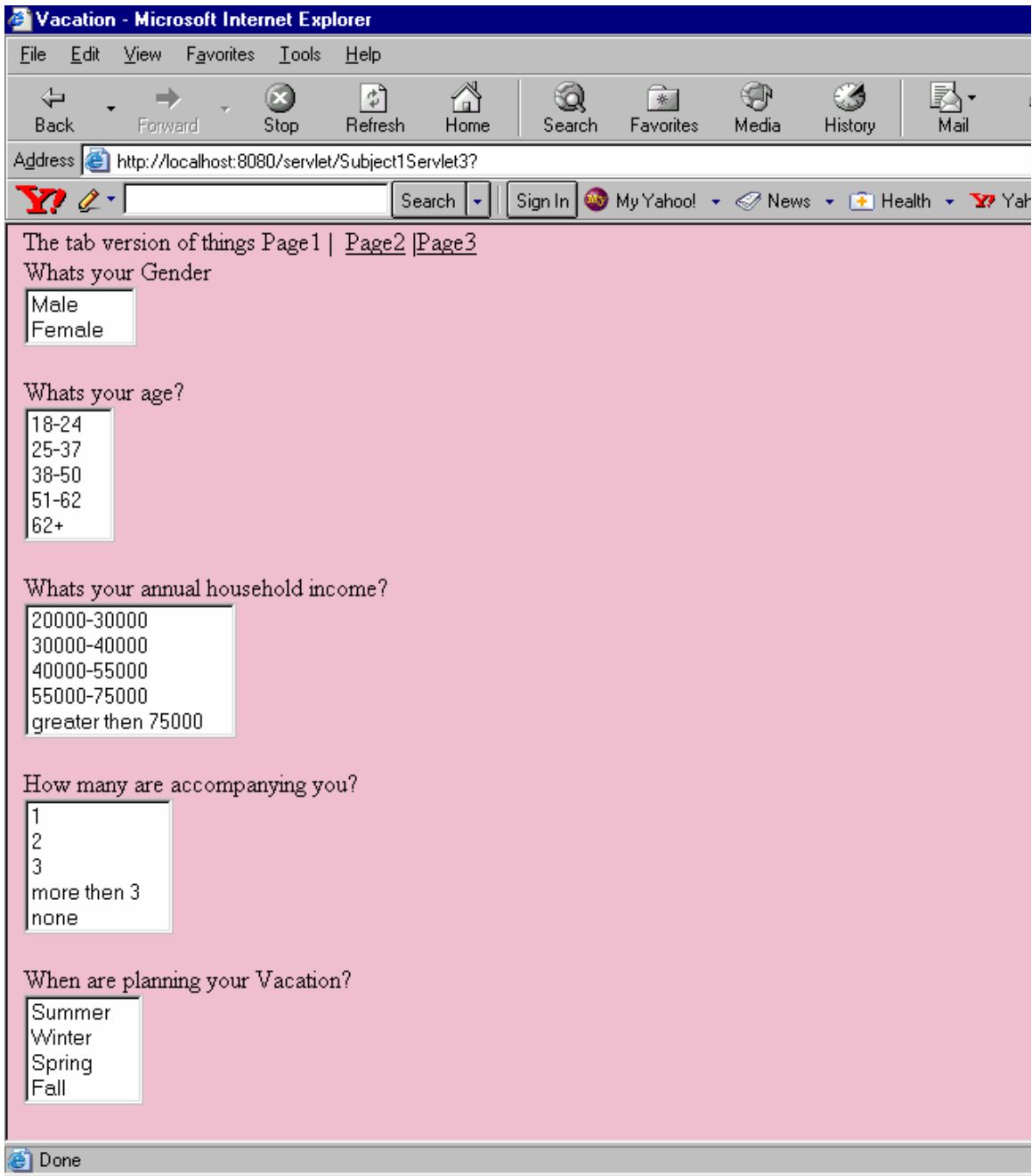
**Figure 3.9 Vacation questionnaire with list box and tab navigation Page 1.**
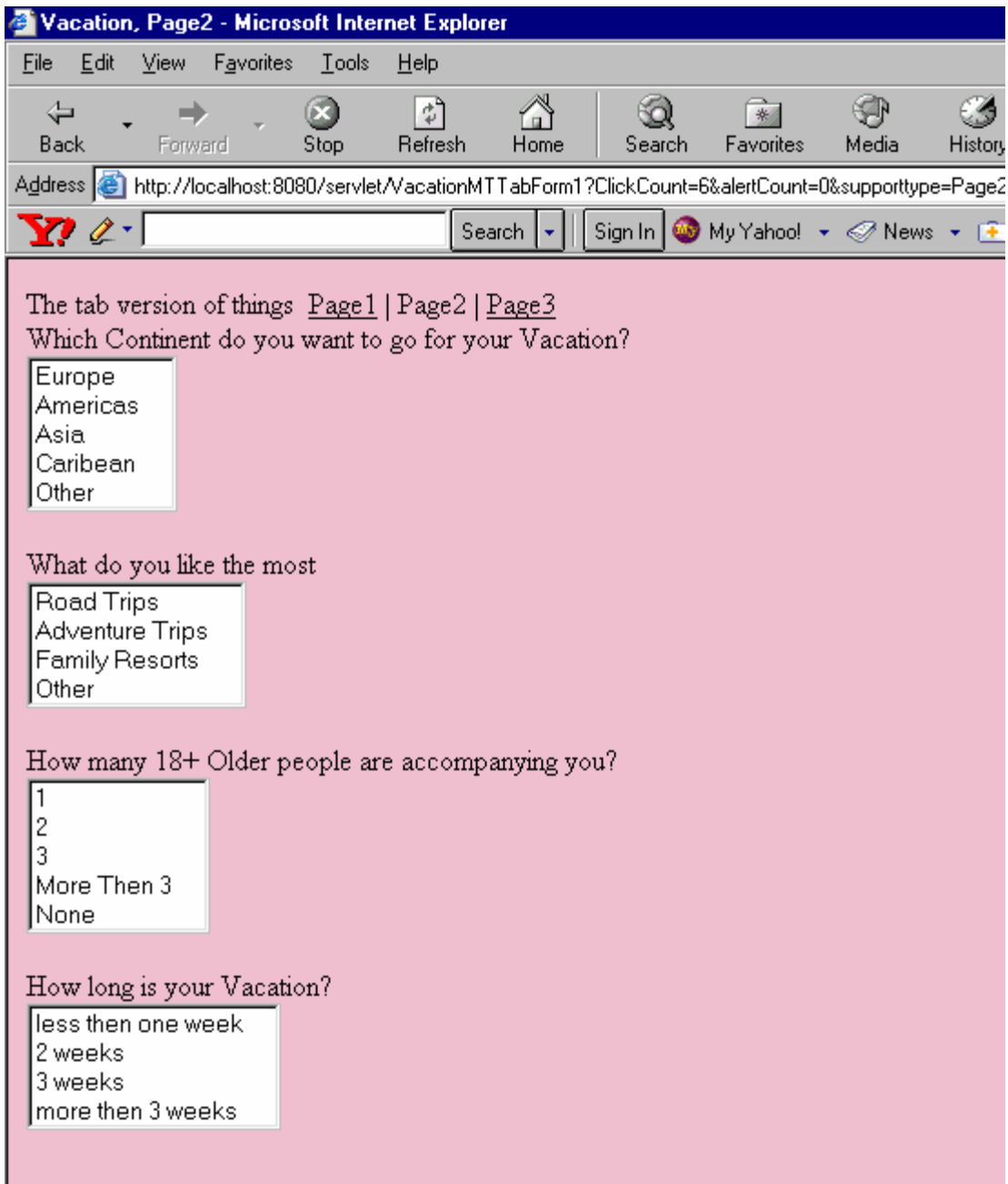
**Figure 3.10 Vacation questionnaire with list box and tab navigation Page 2.**
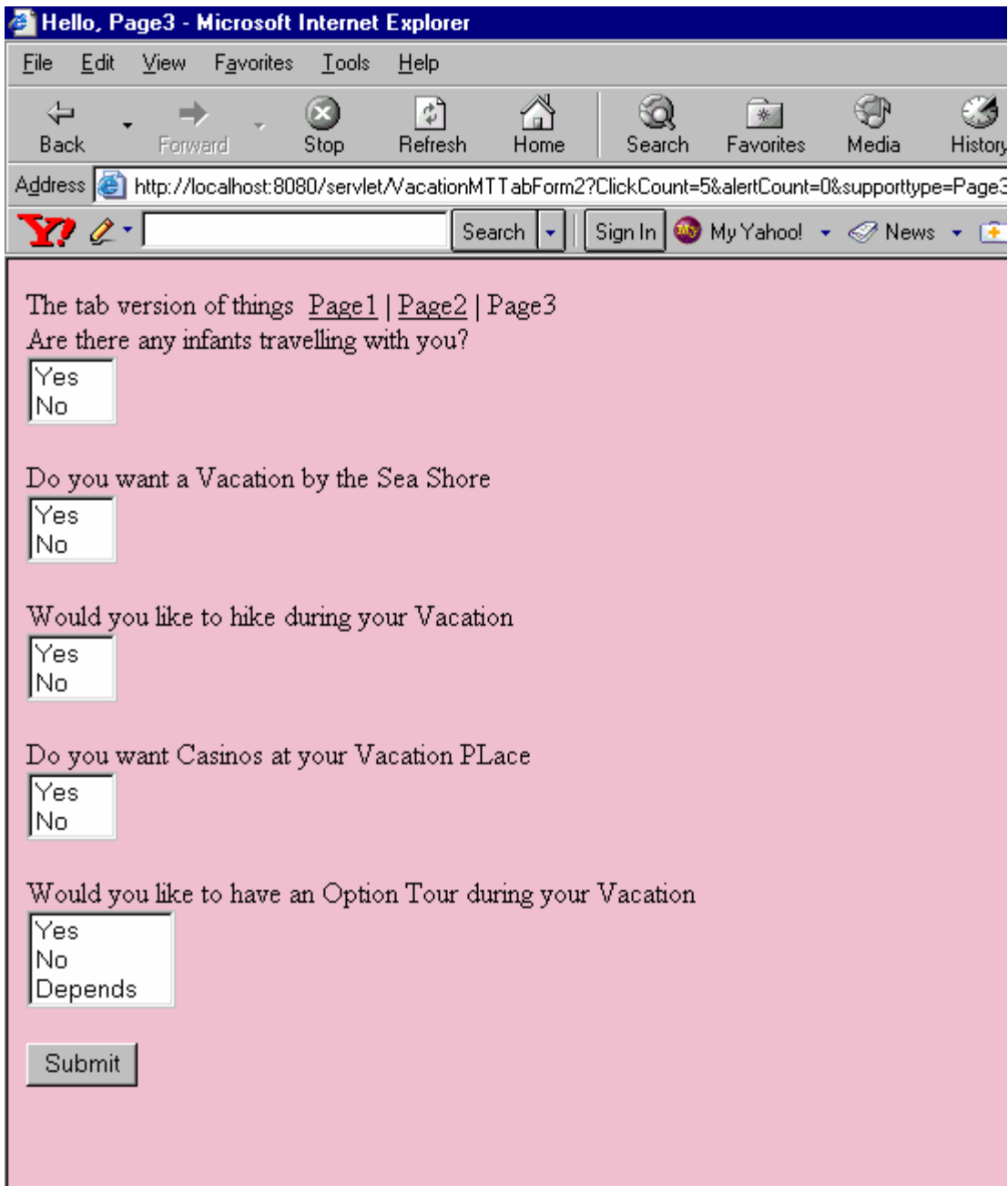
**Figure 3.11 Vacation questionnaire with list box and tab navigation Page 3.**

When the subject submits the form, the time and the number of clicks are recorded and the rank questionnaire is presented to the subject. Figure 3.13 is the screen shot of the rank questionnaire.

**Figure 3.12 Screen shot of the page prior to the Rank questionnaire.**
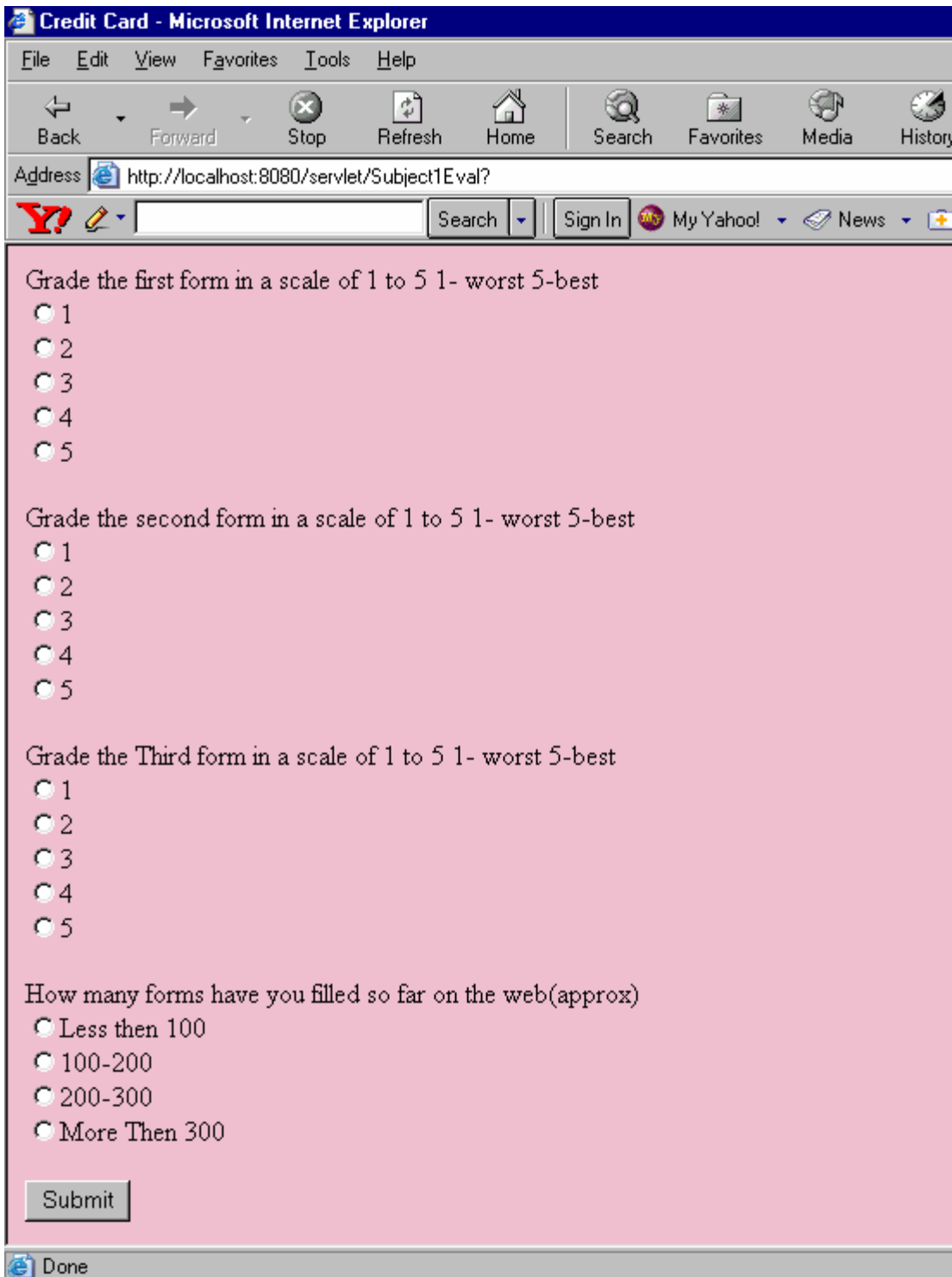
**Figure 3.13 Screen shot of Rank questionnaire.**

## 3.4    Java Servlets

All the forms were generated using Java servlets. The timing started as soon as the forms were displayed to the user. The timer was stopped once the subject submitted each form. A brief description of some of the methods used in the servlets is described below. All these methods were called once the user submitted the forms.

int writeTime (String filename)

This function was used to write the time to a file. This function was called twice for every form, once at the start and the other when the subject clicked and submitted the particular form.

The arguments are:

filename – complete path to the timer file.

Returns 0 if successful, -1 if failure.

int writeClickCount (String filename, int clickCount)

This function was used to write the total number of clicks that the user required in order to reach the objective. The number of clicks included all the additional error clicks. If 14, the number of questions used in the study, is subtracted from this count we get the number of error clicks. This function was called once for every form.

The arguments are:

filename – complete path to the counter file.

clickCount – total number of clicks to complete a particular form.

Returns 0 if successful, -1 on failure.

int writeFormFields (String filename, Vector formFields)

Once all the parameters were obtained from the request object, this function was called to write all the field values to a file. Though the data was collected they were not used to carry out the data analysis.

The arguments are

filename- complete path to the data file.

formFields- vector containing all the data

Returns 0 if successful, -1 on failure.


## 3.5    Javascript

Java script was used on the client side to validate each form. Some of the Java script functions are described briefly below.

checkGroup (form)

This function was called before the form was submitted. The function went through each option in a question to check if the subject had made a valid selection or not.

The arguments are

　　　form - the form object.

　　　Returns true if successful, false on failure


allFieldsValid (form)

When the subject submitted the form this function was called. This function called the checkGroup function described above for all the questions in the form. The form was submitted if and only if the return value of this function was true.

The arguments are

form – the form object.

Returns true if successful, false on failure.

mcount (form)

This function incremented the value of the click counter, which was initialized to zero.

This function was called whenever the subject made a valid selection on any question.

The argument is

form – the form object.

# Chapter 4

# Results

This chapter discusses the results of the statistical analysis performed on the collected data. A box plot generally accompanies computer output of statistics programs [14]. The sample is represented as a box whose top and bottom are drawn at the lower and upper quartiles. The box is divided at the median. A vertical line is drawn from the top of the box to the largest observation that is within 1.5 interquartile range of the top. A similar line is drawn from the bottom to the smallest observation. All observations beyond these limits are plotted individually. The utility of box plots is that they furnish measures of

- Location (the median line)
- Dispersion (the length of the box and the distance between the upper and lower whiskers) and
- Skewness (asymmetry of the upper and the lower portions of the box).

Box plots are useful when two or more samples must be compared. The hypothesis underlying every box plot is explained along with the interpretation of the box plots. In this chapter all the data analysis is explained in detail. Section 4.1 describes the factorial ANOVA. This analysis was carried out to examine if there was an interaction between the factors in our experiment, namely navigation and question display. A non-significant result for the two-way factorial ANOVA lays the ground for a one-way ANOVA of form navigation and question display, which are discussed in sections 4.2 and 4.3 respectively. Initial analysis of data did not take task complexity into account. It was assumed all the questionnaire required the same amount of time from the user. In order to confirm this

assumption, a one-way ANOVA was carried out on task complexity in section 4.4. A significant result in this analysis proved that we had to ignore data collected from health questionnaire. Sections 4.6 and 4.7 are similar to analysis carried out in section 4.2 and 4.3 except for the fact that data from health questionnaire is ignored in these analyses. In sections 4.10 and 4.11 regression analysis was carried out to examine if there is a linear relationship between ranking and the response variables.

## 4.1    Navigation and Question Display Interaction

From Section 2.5 its clear that we need to find out if there is interaction between the factors in the experiments i.e. we need to find out whether the response variable does depend upon the interaction between type of navigation and the display of questions. The factorial two-way ANOVA is carried out separately for the two response variables i.e. time and clicks respectively.

### 4.1.1   Interaction in Credit Questionnaire

In this analysis a two-way ANOVA is carried out to see if there is a significant interaction between navigation and choice display.

Hypothesis: There is no interaction between navigation and the way choices are displayed.

```
Two-way ANOVA: Time versus Display, Navigation

Analysis of Variance for Time
Source          DF        SS        MS        F        P
Display          2       496       248     0.76    0.483
Navigation       2       628       314     0.96    0.402
Interaction      4      1218       305     0.93    0.468
Error           18      5891       327
Total           26      8233
```

**Table 4.1 Two way ANOVA of time versus display and navigation in credit questionnaire.**

```
Two-way ANOVA: Clicks versus Display, Navigation

Analysis of Variance for Clicks
Source          DF        SS        MS        F        P
Display          2      5.41      2.70     1.87    0.183
Navigation       2      5.63      2.81     1.95    0.171
Interaction      4     14.15      3.54     2.45    0.084
Error           18     26.00      1.44
Total           26     51.19
```

**Table 4.2 Two way ANOVA of clicks versus display and navigation in credit questionnaire.**

**Interpretation**

As shown in Tables 4.1 and 4.2 p-values of 0.468 and 0.084 for the interaction term indicates that the result is not significant. Hence the null hypothesis is valid which indicates that are no joint effects of the two factors namely navigation and question display.

**4.1.2   Interaction in Vacation Questionnaire**

An identical analysis is carried out on the Vacation questionnaire.

Hypothesis: There is no interaction between navigation and the way choice are displayed.

```
Two-way ANOVA: Time versus Display, Navigation

Analysis of Variance for Time
Source          DF       SS       MS       F       P
Display          2     1110      555    0.72    0.499
Navigation       2     1687      843    1.10    0.355
Interaction      4     3102      776    1.01    0.428
Error           18    13819      768
Total           26    19719
```

**Table 4.3 Two way ANOVA of time versus display and navigation in vacation questionnaire.**

```
Two-way ANOVA: Clicks versus Display, Navigation

Analysis of Variance for Clicks-H
Source          DF       SS       MS       F       P
Display          2    0.519    0.259    0.39    0.683
Navigation       2    6.741    3.370    5.06    0.018
Interaction      4    9.259    2.315    3.47    0.092
Error           18   12.000    0.667
Total           26   28.519
```

**Table 4.4 Two way ANOVA of clicks versus display and navigation in vacation questionnaire.**

**Interpretation**

The null hypothesis is valid as we get non-significant p-values of 0.428 and 0.092 as shown in Tables 4.3 and 4.4 for the interaction term. It proves that the effect of display on the response variables does not depend on navigation.

### 4.1.3   Interaction in Health Questionnaire

This is an identical analysis, except for the fact it's carried out on the Health questionnaire.

Hypothesis: There is no interaction between navigation and the way choice are displayed.

```
Two-way ANOVA: Time versus Display, Navigation

Analysis of Variance for Time
Source           DF       SS       MS       F        P
Display           2     2921     1460     3.50     0.052
Navigation        2      814      407     0.98     0.396
Interaction       4     3129      782     1.88     0.159
Error            18     7507      417
Total            26    14371
```

**Table 4.5 Two way ANOVA of time versus display and navigation in health questionnaire.**

```
Two-way ANOVA: Clicks versus Display, Navigation

Analysis of Variance for Clicks
Source           DF       SS       MS       F        P
Display           2    2.741    1.370     4.11     0.034
Navigation        2    0.074    0.037     0.11     0.895
Interaction       4    1.926    0.481     1.44     0.260
Error            18    6.000    0.333
Total            26   10.741
```

**Table 4.6 Two way ANOVA of clicks versus display and navigation in health questionnaire.**

**Interpretation**

Tables 4.5 and 4.6 give us the p-values of 0.159 and 0.260 which illustrates the fact that

the null hypothesis is valid.

## 4.2    Analysis of Form Navigation

The results obtained by carrying out ANOVA on the type of navigation are discussed in this section. The underlying hypothesis in these analyses is that the three types are navigation are the same which implies that the response variables do not depend on the type of navigation.

### 4.2.1   Time Analysis

The data on which the ANOVA was performed is the time (in seconds) taken by the subjects to complete each questionnaire.  Figure 4.1 shows the box plots for this analysis.

**Hypothesis:** $\mu_{time\ single\ Page} = \mu_{time\ Next/prev\ Navigation} = \mu_{time\ Tab\ Navigation}$

**One-way ANOVA: Single Page, Next/Prev Navigation, Tab Navigation**

```
Analysis of Variance
Source      DF        SS        MS         F         P
Factor       2        42        21      0.03     0.969
Error       78     52405       672
Total       80     52447
                                Individual 95% CIs For Mean
                                Based on Pooled StDev
Level                  N      Mean     StDev  -----+---------+---------+---------+-
Single Page           27     92.74     24.21      (----------------*---------------)
Next/Prev Navigation  27     91.52     30.51   (----------------*---------------)
Tab Navigation        27     91.04     22.33  (----------------*---------------)
                                       -----+---------+---------+---------+-
Pooled StDev =    25.92              84.0      90.0      96.0     102.0
```

**Table 4.7 One-way ANOVA of time on navigation.**

**Figure 4.1 Box plot of one-way ANOVA of time on navigation**.

**Interpretation**

Table 4.7 gives a p-value of 0.969 indicates that the result is not significant. Hence the null hypothesis is valid. Outlier in data is indicated by a * in Figure 4.1.

### 4.2.2 Mouse Click Analysis

Each questionnaire had 14 questions. The number of mouse clicks that was performed by the subject was also recorded. If the clicks exceeded the number of questions i.e. 14 it was attributed to the quality of question display and the type of navigation. An ANOVA was carried out on the number of clicks for the three types of navigation.

**Hypothesis:** $\mu_{\text{clicks single Page}} = \mu_{\text{clicks Next/Prev Navigation}} = \mu_{\text{clicks Tab Navigation}}$

**One-way ANOVA: Single Page, Next/Prev, Tab Navigation**

```
Analysis of Variance
Source      DF        SS        MS        F        P
Factor       2      2.25      1.12     0.99    0.378
Error       78     88.89      1.14
Total       80     91.14
                                 Individual 95% CIs For Mean
                                 Based on Pooled StDev
Level                     N      Mean     StDev  -+---------+---------+---------+-----
Single Page              27    14.630     0.926          (-----------*-----------)
Next/Prev Navigation     27    14.815     1.442               (----------*-----------)
Tab  Navigation          27    14.407     0.694   (-----------*----------)
                                               -+---------+---------+---------+-----
Pooled StDev =    1.068            14.00     14.35     14.70     15.05
```

**Table 4.8 One-way ANOVA of clicks on navigation.**



Boxplots of Single Page,
Next/Prev and Tab Navigation

(means are indicated by solid circles)

**Figure 4.2 Box plot of one-way ANOVA of clicks on navigation.**

**Interpretation**

A non-significant p-value of 0.378 was obtained as shown in Table 4.8, which illustrates the point that there is no significant difference on the type of display. The stars in the Figure 4.2 correspond to outliers in the data.

## 4.3 Analysis of Question Presentation

ANOVA was carried out on the display of questions. Similar to navigation we can carry out ANOVA on time and on mouse clicks.

### 4.3.1 Time Analysis

The data was the time taken by the subjects (in seconds) to completely answer the questionnaire.

---

**Hypothesis:** $\mu_{time\ Radio\ Button} = \mu_{time\ Drop\ Down\ List} = \mu_{time\ List\ Box}$

**One-way ANOVA: Radio Button, Drop Down List, List Box**

```
Analysis of Variance
Source     DF        SS       MS        F        P
Factor      2      1752      876     1.32     0.273
Error      78     51787      664
Total      80     53539
                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level               N      Mean     StDev  ----+---------+---------+---------+--
Radio Button       27     97.19     27.76                  (---------*---------)
Drop Down List     27     92.81     21.53             (---------*---------)
List Box           27     85.89     27.52  (---------*---------)
                                           ----+---------+---------+---------+--
Pooled StDev =    25.77                       80        90       100       110
```

**Table 4.9 One-way ANOVA of time on question display.**

**Figure 4.3 Box plot of one-way ANOVA of time on display.**

**Interpretation**

Table 4.9 gives a non-significant p-value of 0.273, which illustrates the point that there is no significant difference on the type of display. The box plot for the analysis shown in Figure 4.3 as some outliers in data for list box.

**4.3.2   Click Analysis**

This is similar to the navigation analysis based on the number of mouse clicks. An ANOVA was performed on the number of clicks for the type of display.

**Hypothesis:** $\mu_{clicks\ Radio\ Button} = \mu_{Drop\ Down\ List} = \mu_{clicks\ List\ Box}$

**One-way ANOVA: Radio Button, Drop Down List, List Box**

```
Analysis of Variance
Source      DF        SS        MS        F        P
Factor       2      5.65      2.83     2.58    0.082
Error       78     85.48      1.10
Total       80     91.14
                                 Individual 95% CIs For Mean
                                 Based on Pooled StDev
Level              N     Mean      StDev  ----+---------+---------+---------+--
Radio Button      27   14.889      1.396                    (---------*---------)
Drop Down List    27   14.259      0.712  (---------*----------)
List Box          27   14.704      0.912              (---------*---------)
                                          ----+---------+---------+---------+--
Pooled StDev =   1.047                     14.00     14.40     14.80     15.20
```

**Table 4.10 One-way ANOVA of clicks on question display.**



Boxplots of Radio Button, Drop Down List and List Box

(means are indicated by solid circles)
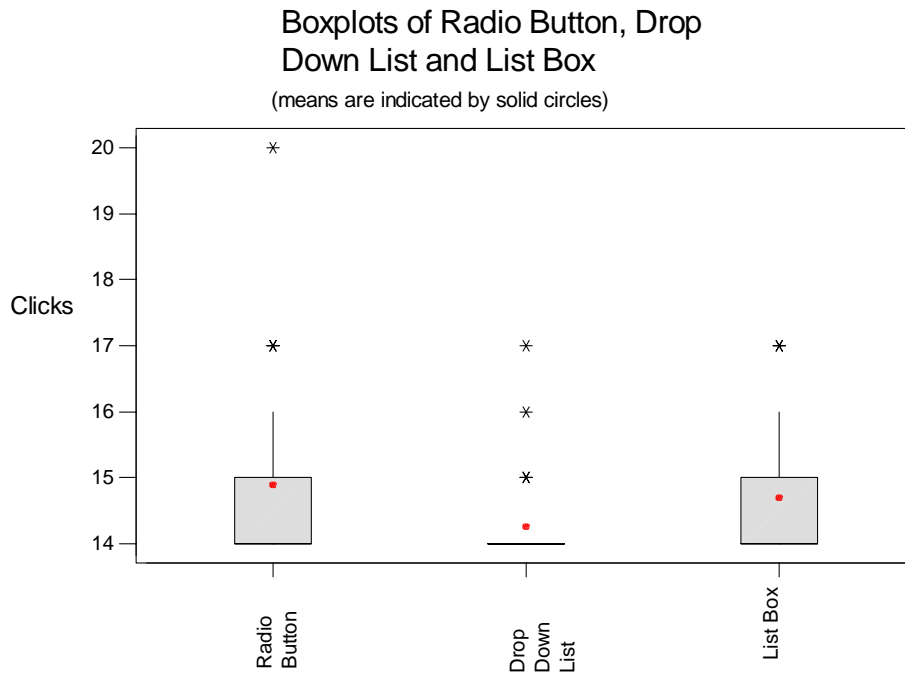
**Figure 4.4 Box Plot of one-way ANOVA of clicks on display.**

**Interpretation**

Table 4.10 gives a p-value of 0.082 that is low, but not significant at 95% confidence. Hence the null hypothesis is still valid.

## 4.4    Analysis of Task Complexity

The subjects were presented with questionnaires in three categories. They were credit, health and vacation choices. The underlying assumption was that all three questionnaires required the same amount of time from the user. We can confirm this by carrying out an ANOVA on the questionnaires.

```
Hypothesis: μtime Credit = μ time Health = μ time Vacation

One-way ANOVA: Credit, Vacation, Health

Analysis of Variance
Source      DF          SS         MS         F         P
Factor       2       11216       5608     10.34     0.000
Error       78       42323        543
Total       80       53539
                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level        N        Mean      StDev   ---------+---------+---------+-------
Credit      27       85.15      17.80     (------*------)
Vacation    27       82.22      23.51   (-------*------)
Health      27      108.52      27.54                       (------*-------)
                                        ---------+---------+---------+-------
Pooled StDev =    23.29                     84        96        108
```

**Table 4.11 One-way ANOVA on task complexity.**

**Boxplots of Credit, Vacation and Health Questionnaires**
(means are indicated by solid circles)
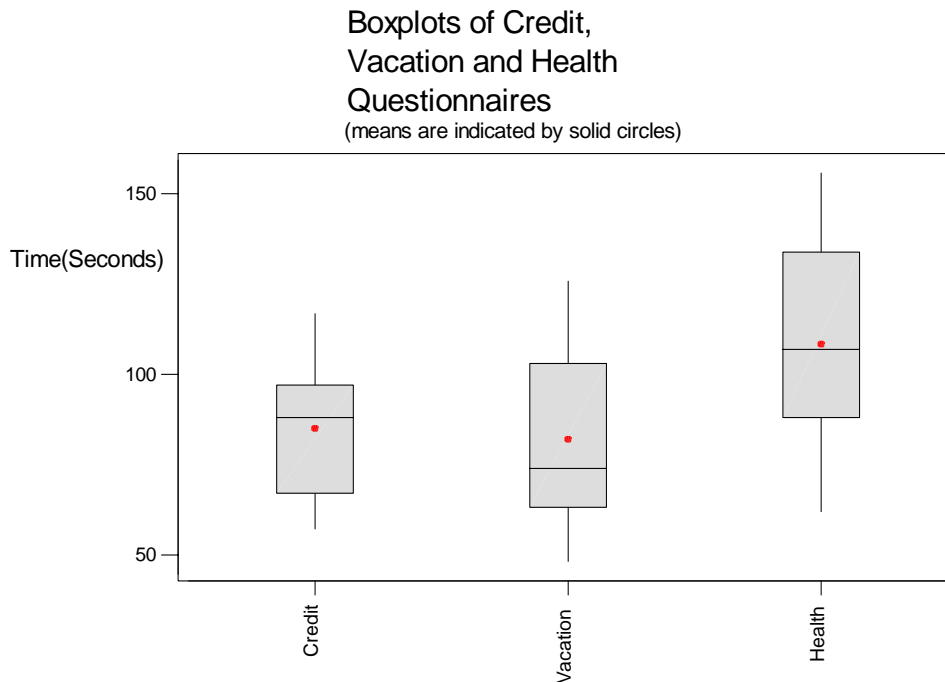
**Figure 4.5 Box plot of one-way ANOVA on task complexity.**

**Interpretation**

We get a highly significant value for p, which is 0 as shown in Table 4.11. This clearly illustrates the fact that health questionnaire takes significantly more time to answer then the other two. Figure 4.5 gives the box plot for the ANOVA.

From analysis of task complexity we can infer that we need to ignore the data collected from our health questionnaire.

## 4.5    Analysis of Task Complexity Ignoring Health Questionnaire

In order to ensure that credit and vacation questionnaire did not differ significantly an ANOVA was carried out with data collected from vacation and credit questionnaire.

**Hypothesis:** $\mu_{\text{time Credit}} = \mu_{\text{time Vacation}}$

**One-way ANOVA: Credit, Vacation**

```
Analysis of Variance
Source      DF        SS       MS        F        P
Factor       1       116      116     0.27    0.608
Error       52     22604      435
Total       53     22720
                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level        N      Mean    StDev   -------+---------+---------+---------
Credit      27     85.15    17.80       (-------------*------------)
Vacation    27     82.22    23.51    (------------*------------)
                                     -------+---------+---------+---------
Pooled StDev =     20.85                78.0      84.0      90.0
```

**Table 4.12 One-way ANOVA on task complexity ignoring health questionnaire.**



**Boxplots of Credit - Vacation**

(means are indicated by solid circles)
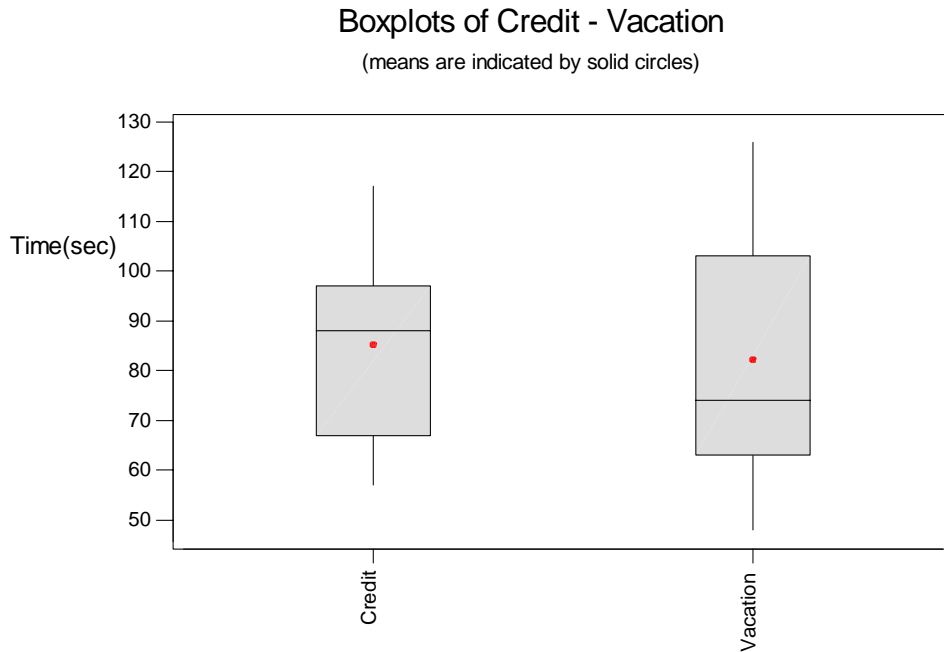
**Figure 4.6 Box plot of ANOVA on task complexity ignoring health questionnaire.**

**Interpretation**

A p-value of 0.608 as seen in Table 4.12 indicates the fact that we can use the data from our Credit and Vacation questionnaire for navigation and type of display experiments. A non-significant p-value proves that on average the time taken to answer Credit and Vacation questionnaire are not extremely different. Figure 4.6 gives the box plot for this analysis.

## 4.6    Form Navigation Ignoring Health Questionnaire

Form navigation data obtained from credit and vacation questionnaire was used to carry out the ANOVA. Since the health questionnaire data was ignored we have 18 samples for type of navigation.

### 4.6.1   Time Analysis

The data on which ANOVA was performed is the time taken by the subjects to complete each questionnaire ignoring health questionnaire.

**Hypothesis:** $\mu_{time\ single\ Page}$ = $\mu_{time\ Next/Prev\ Navigation}$ = $\mu_{time\ Tab\ Navigation}$

**One-way ANOVA: Single Page, Next/Prev Navigation, Tab Navigation**

```
Analysis of Variance
Source     DF       SS       MS        F        P
Factor      2     1231      616     1.46    0.241
Error      51    21488      421
Total      53    22720
                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level              N      Mean     StDev  -+---------+---------+---------+-----
Single Page       18     90.33     20.98                  (--------*---------)
Next/Prev         18     79.33     22.44    (--------*---------)
Tab Navigation    18     81.39     17.90      (--------*---------)
                                         -+---------+---------+---------+-----
Pooled StDev =    20.53                   70        80        90       100
```

**Table 4.13 One-way ANOVA of time on navigation ignoring health questionnaire.**
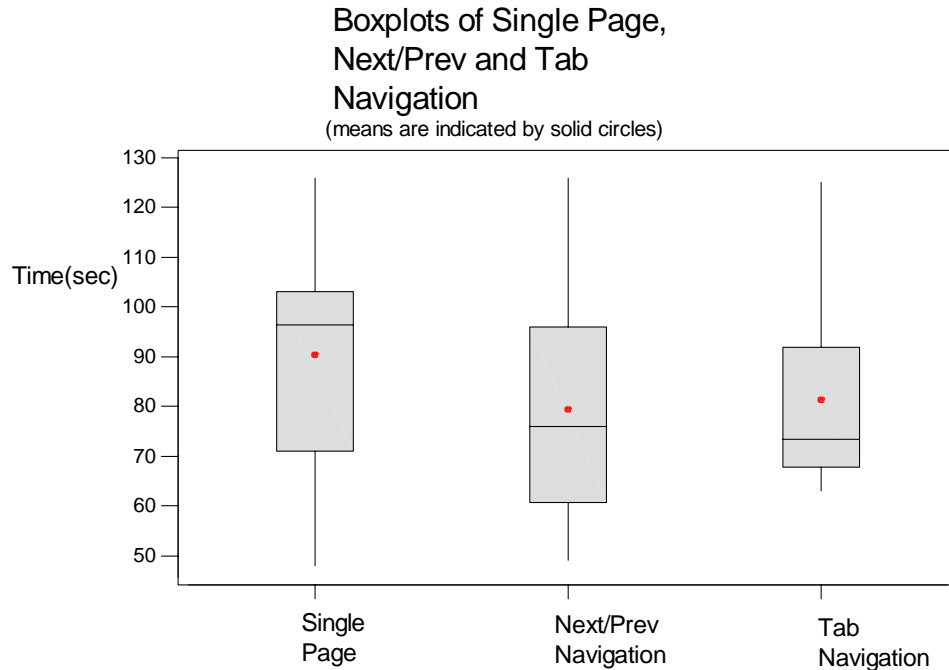


**Figure 4.7 Box plot of one-way ANOVA of time on navigation ignoring health questionnaire.**

**Interpretation**

A high p-value of 0.241 as shown in Table 4.13 proves the fact that there is no significant

difference in the type of navigation.

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### 4.6.2 Click Analysis

This analysis is similar to time but with clicks which is the other response variable.

```
Hypothesis: μclicks single Page = μ clicks Next/Prev Navigation= μ clicks Tab Navigation
One-way ANOVA: Single Page, Next/Prev Navigation, Tab Navigation
Analysis of Variance
Source      DF        SS        MS        F       P
Factor       2       3.37      1.69     1.45    0.244
Error       51      59.22      1.16
Total       53      62.59
                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level            N      Mean     StDev  ----+---------+---------+---------+--
Single Page     18    14.333     0.485  (----------*---------)
Next/Prev       18    14.944     1.626                  (---------*---------)
Tab Navigation  18    14.611     0.778          (---------*---------)
                                         ----+---------+---------+---------+--
Pooled StDev =     1.078              14.00     14.50     15.00     15.50
```

**Table 4.14 One-way ANOVA of clicks on navigation ignoring health questionnaire.**
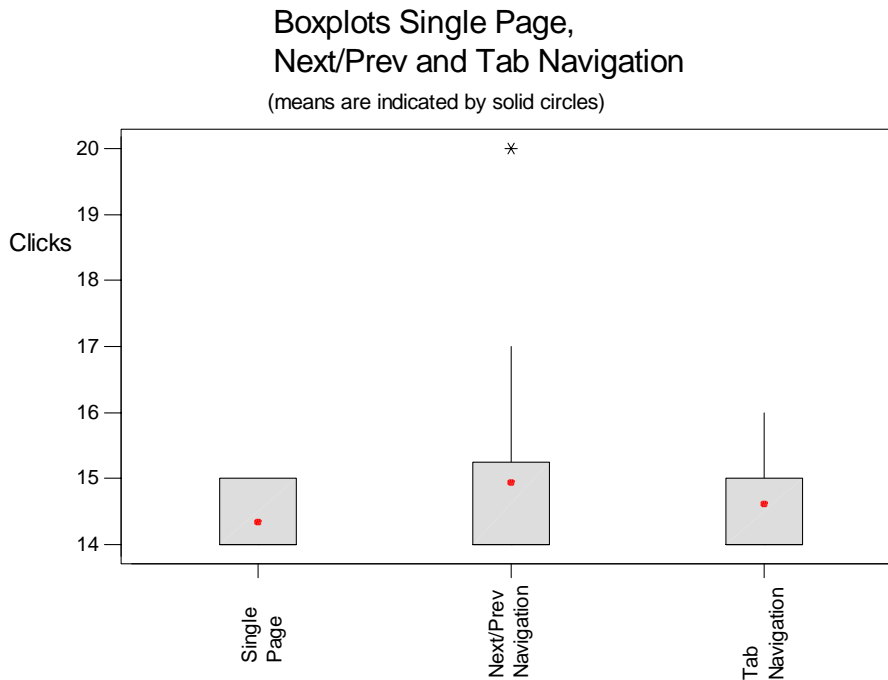


**Figure 4.8 Box Plot of one-way ANOVA of clicks on navigation ignoring health questionnaire.**

**Interpretation**

A high p-value of 0.244 as shown in Table 4.14 proves the fact that there is no significant difference among the three navigations. Figure 4.8 gives the box plot for this analysis

## 4.7    Question Presentation Ignoring Health Questionnaire

The data obtained from the health questionnaire was ignored for this analysis. ANOVA was carried out based on the data obtained from the credit and vacation questionnaire.

### 4.7.1   Time Analysis

An ANOVA was performed on the time taken by the subjects to completely answer the questionnaire.

**Hypothesis:** $\mu_{time\ Radio\ Button} = \mu_{time\ Drop\ Down\ List} = \mu_{time\ List\ Box}$

**One-way ANOVA: Radio Button, Drop Down List, List Box**

```
Analysis of Variance
Source      DF        SS        MS        F        P
Factor       2      2575      1288     3.26     0.047
Error       51     20144       395
Total       53     22720
                                Individual 95% CIs For Mean
                                Based on Pooled StDev
Level           N      Mean     StDev  ------+---------+---------+---------+
Radio Button    18     87.94     21.79                     (--------*--------)
Drop Down List  18     89.17     22.61                       (--------*---------)
List Box        18     73.94     14.11    (--------*--------)
                                          ------+---------+---------+---------+
Pooled StDev =    19.87                        70        80        90       100
```

**Table 4.15 One-way ANOVA of time on question presentation ignoring health questionnaire.**

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## Boxplots of RadioButton, Drop Down List and List Box

(means are indicated by solid circles)
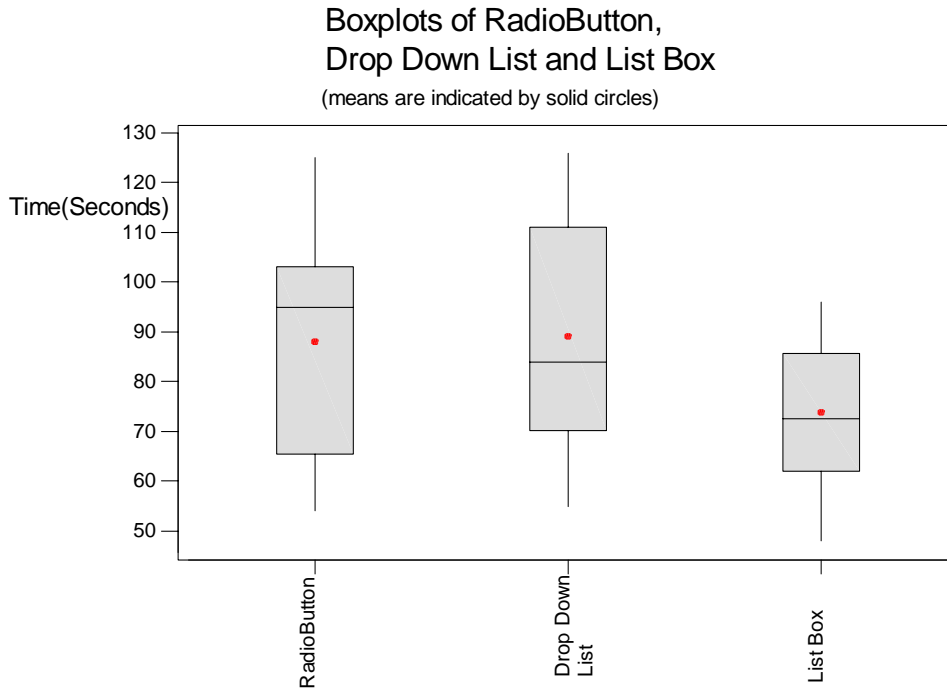


**Figure 4.9 Box Plot of one-way ANOVA of time on display ignoring health questionnaire.**

**Interpretation**

A p-value of 0.046 as shown in Table 4.15 indicates that it is a significant result. Hence the null hypothesis is rejected. There is significant difference between the means based on the type of display. Questionnaire with list box take less time compared to radio button and drop down list. The box plot for this analysis is shown in Figure 4.9.

.

### 4.7.2 Click Analysis

A similar analysis as above was carried out based on clicks.

```
Hypothesis: μclicks Radio Button = μ Drop Down List = μ clicks List Box

One-way ANOVA: Radio Button, Drop Down List, List Box

Analysis of Variance
Source      DF        SS        MS        F        P
Factor       2      7.37      3.69     3.40    0.041
Error       51     55.22      1.08
Total       53     62.59
                                Individual 95% CIs For Mean
                                Based on Pooled StDev
Level          N     Mean     StDev  --------+---------+---------+--------
Radio Button  18   14.944     1.552                 (---------*---------)
Drop Down List 18  14.111     0.323  (---------*---------)
List Box      18   14.833     0.857               (---------*---------)
                                     --------+---------+---------+--------
Pooled StDev =   1.041              14.00     14.50     15.00
```

**Table 4.16 One-way ANOVA of clicks on question presentation ignoring health questionnaire.**
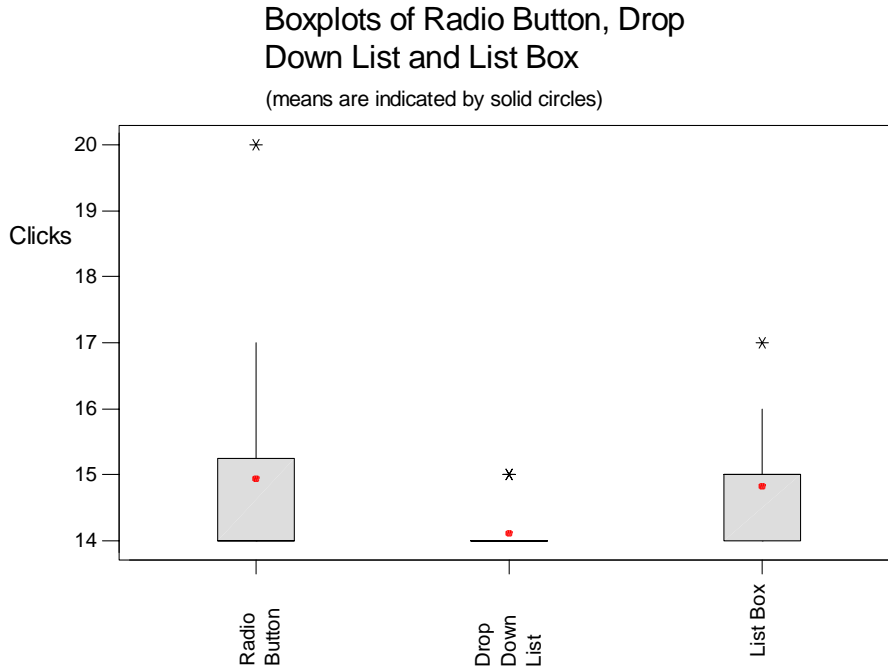
**Figure 4.10 Box plot of One-way ANOVA of clicks on display ignoring health questionnaire.**

**Interpretation**

The p-value of 0.041 as seen in Table 4.16 indicates that it is a significant result at 95% confidence limit. Hence the null hypothesis is rejected. There is significant difference on number of clicks based on the type of display. Questionnaire with drop down list take less number of clicks compared to radio button and list box.

## 4.8    Two Sample T-test and Confidence Interval on Time

From the analysis in section 4.7.1 it is clear that list box takes less time compared to radio button. A student t-test can put confidence interval on the mean difference [15]. The results of the t-test are discussed in this section.

### 4.8.1 Two-Sample T-Test and CI: Radio Button, List Box

The results of the two-sample T-test are shown. This T-test determines confidence intervals between the means of radio button and list box.

```
Two-sample T for Radio Button vs List Box

              N      Mean     StDev   SE Mean
Radio Button  18      87.9     21.8       5.1
All Text      18      73.9     14.2       3.3


Difference = μRadio Button - μList Box
Estimate for difference:  14.06
95% CI for difference: (1.51, 26.60)
T-Test of difference = 0 (vs not =): T-Value = 2.29  P-Value = 0.029  DF = 29
```

**Table 4.17 Two-sample T-test of time between radio button and list box.**

**Interpretation**

The estimate for mean difference is 14.06 seconds as seen in Table 4.17, which means that on average it takes 14.06 seconds more to answer questionnaire based on radio button then it takes when the questions are displayed in list box format.

### 4.8.2 Two-Sample T-test and CI: Drop Down List, List Box

A similar t-test between drop down list and list box was performed to estimate the mean difference between them. The output of the t-test is shown.

```
Two-sample T for Drop Down List vs List Box

                  N      Mean     StDev   SE Mean
Drop Down List   18      89.2     22.6       5.3
List Box         18      73.9     14.2       3.3


Difference = μDrop Down List - μList Box
Estimate for difference:  15.28
95% CI for difference: (2.38, 28.17)
T-Test of difference = 0 (vs not =): T-Value = 2.43  P-Value = 0.022  DF = 28
```

**Table 4.18 Two-sample T-test of time between drop down list and list box.**

**Interpretation**

Table 4.18 indicates that on average it takes 15.28 seconds more time to answer questions when displayed in drop down list compared to list box.

## 4.9    Two Sample T-test and Confidence Interval on Clicks

The analysis in section 4.7.2 showed that a drop down list takes fewer clicks compared to radio button and list box. A student t-test is used to place a confidence interval on the mean difference. The results of the t-test are discussed in this section.

### 4.9.1   Two-Sample T-Test and CI: Radio Button, Drop Down List

A student t-test puts a confidence interval on the mean difference between radio button and drop down list. The results from the t-test is shown in Table 4.19

```
Two-sample T for Radio Button vs Drop Down List

                N       Mean      StDev    SE Mean
Radio Button    18      14.94      1.55      0.37
Drop Down List  18      14.111     0.323     0.076


Difference = mu Radio Button - mu Drop Down List
Estimate for difference:  0.833
95% CI for difference: (0.048, 1.618)
T-Test of difference = 0 (vs not =): T-Value = 2.23  P-Value = 0.039  DF = 18
```

**Table 4.19 Two-sample T-test on clicks between radio button and drop down list.**

**Interpretation**

On average it takes 0.833 more clicks to answer questions when displayed in radio button compared to drop down list.

### 4.9.2   Two-Sample T-Test and CI: List Box, Drop Down List

A t-test was performed between list box and drop down list to place a confidence interval

on their mean difference as shown in Table 4.20.

```
Two-sample T for List Box vs Drop Down List

                   N      Mean      StDev    SE Mean
List Box          18    14.833     0.857      0.20
Drop Down List    18    14.111     0.323      0.076

Difference = mu List Box - mu Drop Down List
Estimate for difference:  0.722
95% CI for difference: (0.273, 1.171)
T-Test of difference = 0 (vs not =): T-Value = 3.34  P-Value = 0.003  DF = 21
```

**Table 4.20 Two-sample T-test on clicks between list box and drop down list.**


**Interpretation**

It takes 0.722 less clicks on average to answer questions when displayed in list box to

drop down list.


## 4.10   Ranking and Time

As part of the questionnaire each user was asked to rank each form. The ranking scale

ranged from 1 to 5. The regression analysis was carried out between Time and Ranking

[16].

```
The regression equation is
Time = 97.3513 - 1.45971 Ranking

S = 25.9813      R-Sq = 0.4 %      R-Sq(adj) = 0.0 %

Analysis of Variance

Source            DF          SS          MS          F          P
Regression         1       211.6     211.550   0.313394    0.577
Error             79     53327.3     675.030
Total             80     53538.9
Pearson correlation of Ranking and Time = -0.063
```

**Table 4.21 Regression analysis time versus ranking.**

## Regression Plot

Time = 97.3513 - 1.45971 Ranking

S = 25.9813     R-Sq = 0.4 %     R-Sq(adj) = 0.0 %
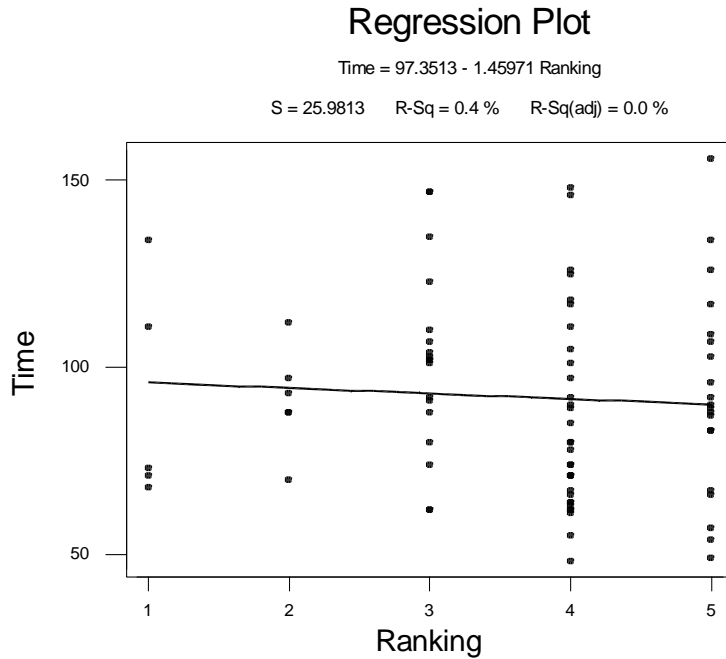


**Figure 4.11 Regression Plot Time versus Ranking.**

**Interpretation**

A negative correlation of −0.063 is obtained as seen in Table 4.21 that is consistent with the graph shown in Figure 4.11. Such a low value of Pearson coefficient means that the regression is not very strong. It is very clear that there is no linear relationship ranking and time.

## 4.11 Ranking and Clicks

A regression analysis was performed between ranking and the number of clicks it took to complete the form.

```
The regression equation is
Clicks = 14.4153 + 0.0547128 Ranking


S = 1.07231     R-Sq = 0.3 %      R-Sq(adj) = 0.0 %


Analysis of Variance

Source           DF         SS         MS          F      P
Regression        1     0.2972    0.29721   0.258472  0.613
Error            79    90.8386    1.14986
Total            80    91.1358
Pearson correlation of Ranking and Clicks = 0.057
```

**Table 4.22 Regression analysis of clicks versus ranking.**
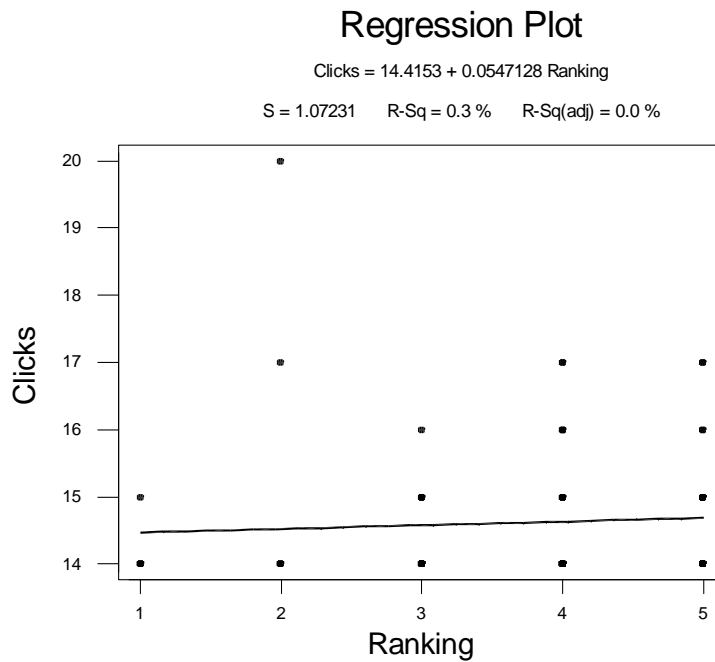


**Figure 4.12 Regression Plot Clicks versus Ranking.**

**Interpretation**

The 0.057 Pearson coefficient as seen in Table 4.22 indicates the correlation is very

weak. The regression analysis clearly indicates the fact that ranking and clicks don't have

a linear relationship. Figure 4.12 is the regression plot.

## 4.12 Click Analysis Revisited

In the analysis thus far, the first click on the drop down list to view the choices was not taken in to account. Also the clicks on the next and previous links and the clicks on tabs to navigate among pages were not taken into account as mouse clicks. The analysis in this section takes into the account the click to view the choices in a drop down list and the clicks on the navigation links.

### 4.12.1 Form Navigation

Clicks on Form Navigation were taken as valid clicks and ANOVA was performed with clicks.

```
Hypothesis: μclicks single Page = μ clicks Next/Prev Navigation= μ clicks Tab Navigation

One-way ANOVA: SinglePage, Next/Prev Navigation, Tab Navigation

Analysis of Variance
Source      DF        SS        MS         F        P
Factor       2      71.4      35.7      0.85     0.431
Error       51    2131.4      41.8
Total       53    2202.8
                                   Individual 95% CIs For Mean
                                   Based on Pooled StDev
Level                   N     Mean     StDev  -------+---------+---------+---------
SinglePage             18   19.000     6.686   (-----------*-----------)
Next/Prev Navigation   18   21.611     6.279              (-----------*------------)
Tab Navigation         18   21.222     6.422               (-----------*-----------)
                                              -------+---------+---------+---------
Pooled StDev =    6.465                        17.5      20.0      22.5
```

**Table 4.23 One-way ANOVA of clicks on form navigation with revised click count.**

Boxplots of SinglePage,
Next/Prev and Tab
Navigation
(means are indicated by solid circles)
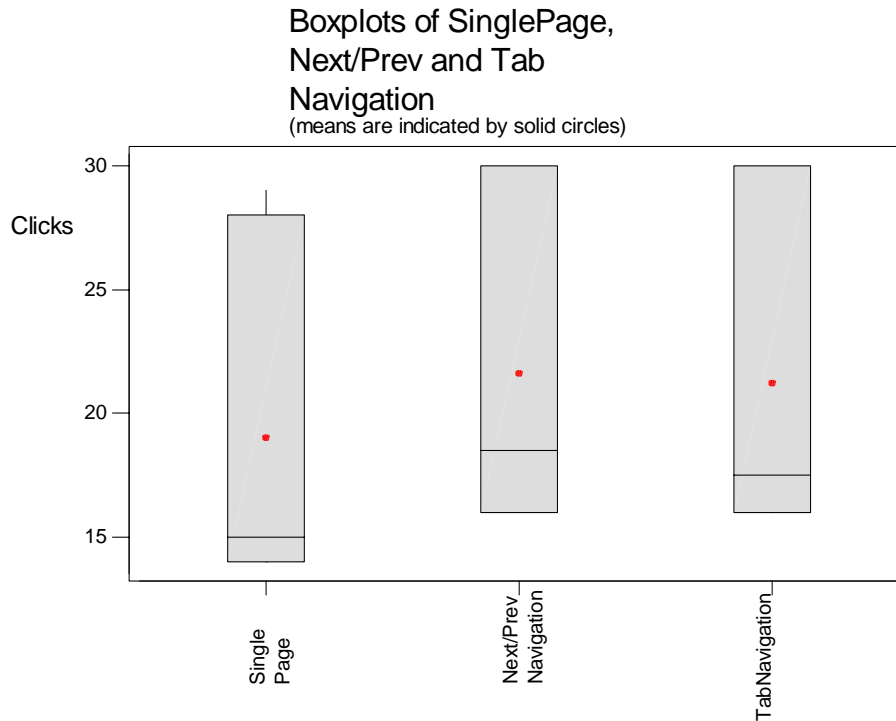
**Figure 4.13 Box Plot of one-way ANOVA of clicks on form navigation with revised click count.**

**Interpretation**

A high p-value of 0.431 as shown in Table 4.23 proves the fact that there are no significant differences among the three navigations. Figure 4.13 gives the box plot for this analysis.

**4.12.2 Question Presentation**

ANOVA was performed on the total number of clicks taken by the subjects to completely answer the questionnaire.

**Hypothesis:** $\mu_{\text{clicks Radio Button}} = \mu_{\text{Drop Down List}} = \mu_{\text{clicks List Box}}$

**One-way ANOVA: Radio Button, Drop Down List, List Box**
```
Analysis of Variance
Source      DF       SS       MS        F         P
Factor       2   2098.04  1049.02   429.53    0.000
Error       51    124.56     2.44
Total       53   2222.59
                                Individual 95% CIs For Mean
                                Based on Pooled StDev
Level              N      Mean    StDev   --+---------+---------+---------+---
-
Radio Button      18    16.278    2.109   (-*-)
Drop Down List    18    29.444    0.984
(-*)
List Box          18    16.167    1.383   (*-)
                                 --+---------+---------+---------+----
Pooled StDev =    1.563          16.0     20.0      24.0      28.0
```

**Table 4.24 One-way ANOVA of clicks on question display with revised click count.**



**Figure 4.14 Box plot of ANOVA of clicks on display with revised click count.**

**Interpretation**

A p-value of 0.000, as seen in Table 4.24, indicates that this is a significant result at 95%

confidence limit. Hence the null hypothesis is rejected. There is significant difference on

the number of mouse clicks based on the type of display. Questionnaires with drop down list take significantly more clicks compared to radio button and list box.

### 4.12.3 Two Sample T-test and CI: Drop Down List, Radio Button

From the analysis in section 4.12.2 it is clear that drop down list takes more clicks compared to list box. A student t-test can place confidence intervals on the mean difference. The results of the two-sample T-test are shown in Table 4.25.

```
Two-sample T for Drop Down List vs Radio Button

                  N       Mean      StDev    SE Mean
Drop Down List   18      29.444     0.984      0.23
Radio Button     18      16.28      2.11       0.50


Difference = μ_Drop Down List − μ_Radio Button
Estimate for difference:   13.167
95% CI for difference: (12.035, 14.299)
T-Test of difference = 0 (vs not =): T-Value = 24.01   P-Value = 0.000   DF = 24
```

**Table 4.25 Two-sample T-test on clicks between drop down list and radio button with revised click count.**

**Interpretation**

The estimate for the mean difference is 13.167 clicks as seen in Table 4.25, which means that on average it took 13.167 more clicks to answer questionnaire based on drop down list than it takes when the questions are displayed in radio button format.

### 4.12.4 Two Sample T-Test and CI: Drop Down List, List Box

A t-test was performed between drop down list and list box to place a confidence interval on their mean difference as shown in Table 4.26.

```
Two-sample T for Drop Down List vs List Box

               N       Mean     StDev    SE Mean
Drop Down List  18     29.444    0.984     0.23
List Box        18     16.17     1.38      0.33


Difference = μ_Drop Down List − μ_List Box
Estimate for difference:  13.278
95% CI for difference: (12.461, 14.095)
T-Test of difference = 0 (vs not =): T-Value = 33.20  P-Value = 0.000  DF = 30
```

**Table 4.26 Two-sample T-test on clicks between drop down list and list box with revised click count**

**Interpretation**

It took 13.278 more clicks on average to answer questions when displayed in drop down list compared to list box.

**4.12.5 Regression Analysis of Ranking and Clicks**

This analysis is identical to analysis carried out in section 4.11 but this takes into account the click on drop down list to view choices and the clicks on the navigation links. A regression analysis was performed between ranking and the number of clicks it took to complete the form.

```
The regression equation is
Clicks = 18.6168 + 0.488436 Ranking

S = 6.51001      R-Sq = 0.7 %        R-Sq(adj) = 0.0 %

Analysis of Variance

Source            DF          SS        MS          F        P
Regression         1       23.69    23.6861   0.558895   0.457
Error             79     3348.04    42.3803
Total             80     3371.73
Pearson correlation of Ranking and clicks = 0.488
```

**Table 4.27 Regression Analysis of clicks versus ranking with revised click count.**

## Regression Plot

Clicks = 18.6168 + 0.488436 Ranking

S = 6.51001    R-Sq = 0.7 %    R-Sq(adj) = 0.0 %
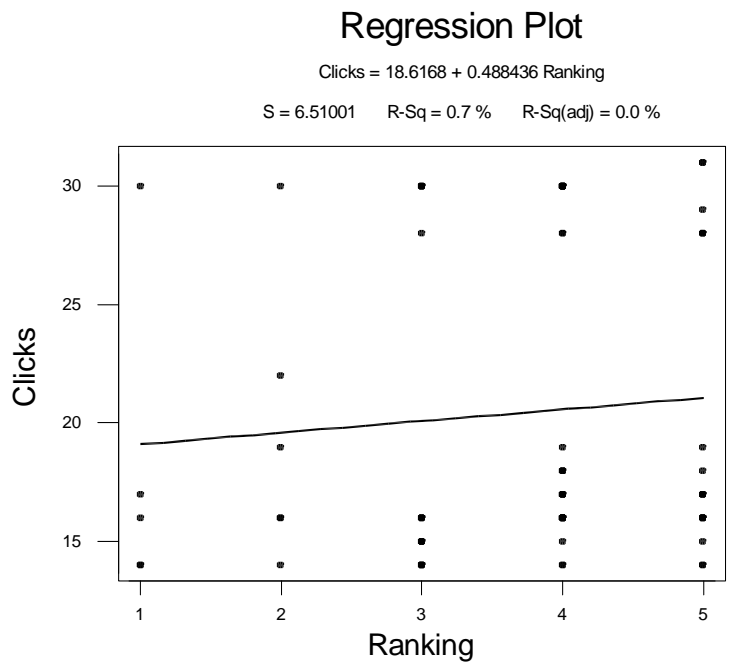


**Figure 4.15 Regression plot clicks versus ranking with revised click count.**

**Interpretation**

The 0.488 Pearson coefficient as seen in Table 4.27 indicates that the correlation is not very strong. The regression analysis clearly indicates the fact that ranking and clicks do not have a linear relationship. Figure 4.15 includes the regression plot.

## 4.13   Summary

Analysis of question presentation ignoring health questionnaire (section 4.7) proved that list box takes less time compared to radio button and drop down list. It also evinced the fact that drop down list takes fewer clicks compared to radio button and list box.

A two-sample t-test as discussed in section 4.8 put confidence interval on the mean difference in time. On average it takes less time for the user to answer questions when displayed in list box format. We think this can be attributed to the fact that the user can see the choices clearly, which decreases the selection time.

Analysis carried out in section 4.9 illustrates that it takes fewer clicks when questions are displayed as drop down list. Its possible drop down list increases the user locus of attention leading to lesser to clicks. A larger comprehensive study is required to reveal the true cause for this observation.

# Chapter 5

# Conclusions

The objective of this experiment was to study the effect of navigation and question display on user responses. The time and the number of clicks by each human subject were recorded. A two-way ANOVA was carried out to determine if there was any interaction between navigation and question display. A non-significant result was obtained for the interaction factor yielding out a path to carry out one-way ANOVA between the similar graphical user interface components. A one-way ANOVA between the similar components came up with a non-significant result, but an ANOVA on task complexity lead to significant result with a p-value of 0.00, illustrating the fact that the health questionnaire consumed more time to answer then the other two questionnaires used in the study namely credit and vacation. Hence the data collected from health questionnaire has to be ignored for analysis.

In order to confirm the fact that the credit and vacation questionnaire could be used for analysis, a one-way ANOVA was performed on the data collected from the two questionnaires and a non-significant result was obtained proving the fact that vacation and credit data can be used for further analysis on components. ANOVA for the type of navigation gave a non-significant p-value of 0.238. But an ANOVA of time on the display component gave a significant result of 0.042 proving the fact that list boxes take less time compared to radio buttons and drop down lists. A two-sample t-test was performed to place confidence limits on the mean differences in time between list box

and the other two display components. An ANOVA of clicks based on the display component also came up with a significant result.

The analysis proved the fact that drop down lists take fewer clicks compared to radio buttons and list box. As part of the study the subjects were asked to rank the forms on a scale of 1-5, 1 being worst and 5 being the best. Two regression analyses were performed, one based on ranking versus time and the other being ranking versus clicks. Very low correlation coefficients were obtained evincing the fact there were no strong relationship between rank and the response variables.

## 5.1 Contributions

The contributions of this work include establishing:

- List boxes take less time when compared to radio buttons and drop down list.

- Drop down lists require fewer number of clicks.

- There is strong preference for all three types of navigation, namely, Single Page, Next/Previous and Tab Navigation.

- There is no correlation between the user preference and the time the user takes to complete a given task.

## 5.2 Limitations

There is an inherent limitation in any ANOVA with 95% confidence limit and that is the fact that one out of 20 experiments will turn out to be significant. Even though 27 subjects participated in this study it is theoretically possible that this sample group can fall in the 5% region making the results entirely by chance. Another limitation of this

study is the fact that mouse clicks during an experiment need not represent the complexity of the form. Scrolling down on a form with Single Page navigation should be factored in as a weighted mouse click.

## 5.3 Future Work

Possible extensions of this study can include:

- Investigate the impact of the complexity of questions on both time and clicks. The challenge would be to come up with a design that takes into account complexity and ease of navigation and type of option display.

- Carry out experiments using more human subjects.

- Run the experiment both on site (as done) and on-line with remote subjects. This would provide a larger and more diverse group of users.

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# Appendix A

## A.1 Health Questionnaire

1) What's your Gender?

      (i)      Male

      (ii)     Female

2) Are you a Vegetarian?

      (i)      Yes

      (ii)     No

3) Choose Your Program Goal:

      (i)      My goal is to lose more than 20 pounds

      (ii)     My goal is to lose 10-20 pounds

      (iii)    My goal is to lose 5 pounds

      (iv)    My goal is not to lose but stay fit

4) For me, the most important benefit of an online diet is:

      (i)      Convenience

      (ii)     Personalization

      (iii)    Privacy

      (iv)    Support

      (v)     Effectiveness

5) Do you have any of the following health conditions?

      (i)      High Blood Pressure

      (ii)     Heart Disease

      (iii)    High Blood Cholesterol

      (iv)    Type 2 Diabetes, Non-Insulin Controlled

      (v)     Type 1 or Type 2 Diabetes, Insulin Controlled

      (vi)    None of the above


6) Do you drink alcoholic beverages?

      (i)     Yes

      (ii)    No


7) Are you pregnant or breastfeeding a child as their main source of nutrition?

      (i)     Yes

      (ii)    No


8) How often should you drink water during a workout or sports activity?

      (i)     Every 15min

      (ii)    Every 30min

      (iii)    Every Hour

      (iv)    Every 2hours


9) I have no doubt that I will reach my goal weight?

(i)     Strongly Agree

(ii)    Strongly Disagree

(iii)   Agree

(iv)    Disagree

(v)     Slightly Agree

(vi)    Slightly Disagree


10) There are advantages or benefits to remaining overweight?

(i)     Strongly Agree

(ii)    Strongly Disagree

(iii)   Agree

(iv)    Disagree

(v)     Slightly Agree

(vi)    Slightly Disagree


11) I find I often eat in response to tension and stress.

(i)     Strongly Agree

(ii)    Strongly Disagree

(iii)   Agree

(iv)    Disagree

(v)     Slightly Agree

(vi)    Slightly Disagree

12) While exercising, my mind is focused on the task at hand and I am enjoying myself.

      (i)       Strongly Agree

      (ii)     Strongly Disagree

      (iii)    Agree

      (iv)    Disagree

      (v)     Slightly Agree

      (vi)    Slightly Disagree


13) Each Day the average adult should consume (in calories).

      (i)     2000

      (ii)    1800

      (iii)   1500

      (iv)   1200


14) The Order in which you exercise matters?

      (i)     Yes

      (ii)    No

## A.2 Credit Questionnaire

1) Which card feature would you find most useful:

    (i)       Earning Points redeemable for travel or other products and services

    (ii)     Earning cash back with every purchase

    (iii)    Saving money with low interest rates

    (iv)    Managing debt through balance transfers


2) Which types of reward points interest you the most?

    (i)       Airline frequent flyer miles

    (ii)     Hotel Rewards

    (iii)    Golf Equipment, instruction and apparel

    (iv)    Not Interested in rewards, just low interest rates and balance transfers


3) Do you plan to use your card for on-line shopping?

    (i)       Yes

    (ii)     No


4) How do you prefer to pay your bill?

    (i)       In partial payments overtime

    (ii)     In full each month

    (iii)    In full most months, but with the flexibility to extend payments


5) Do you plan to use this card to get cash from ATM?

(i)    Yes

(ii)    No


6) What's your age? (You must be over 18 to apply for a credit card)

(i)    18-24

(ii)    25-37

(iii)    38-50

(iv)    51-62

(v)    62+


7) What's your School Year?

(i)    Freshman

(ii)    Sophomore

(iii)    Junior

(iv)    Graduate

(v)    Doesn't Apply


8) What's your annual household income?

(i)    20000-30000

(ii)    30000-40000

(iii)    40000-55000

(iv)    55000-75000

(v)    Greater then 75000

9) What's your employment status?

     (i)       Full-Time

     (ii)     Part-Time

     (iii)    Retired

     (iv)    Unemployed


10) Do you

     (i)       Own Home

     (ii)     Rent Home

     (iii)    Live With Parents

     (iv)    Other


11) Do you have a car?

     (i)       Yes

     (ii)     No


12) Do you have?

     (i)       Checking Account

     (ii)     Savings Account

     (iii)    Both


13) Rate Your Credit History: (5 being the best)

(i)     1

(ii)    2

(iii)   3

(iv)    4

(v)     5


14) Do you currently hold a Credit Card?

(i)     Yes

(ii)    No

## A.3   Vacation Questionnaire

1) What's your Gender?

    (i)      Male

    (ii)     Female


2) What's your age?

    (i)      18-24

    (ii)     25-37

    (iii)    38-50

    (iv)    51-62

    (v)     62+


3) When are planning your Vacation?

    (i)      Summer

    (ii)     Winter

    (iii)    Spring Break

    (iv)    Fall Break


4) What's your annual household income?

    (i)      20000-30000

    (ii)     30000-40000

    (iii)    40000-55000

    (iv)    55000-75000

(v)    Greater then 75000

5) How many are accompanying you?

(i)    None

(ii)    1

(iii)    2

(iv)    3

(v)    More then 3

6) Which continent do you want to go for your Vacation?

(i)    Europe

(ii)    Americas

(iii)    Asia

(iv)    Caribbean

(v)    Other

7) What do you like the most?

(i)    Road Trips

(ii)    Adventure Trips

(iii)    Family Resorts

(iv)    Other

8) How many 18+ older people are accompanying you?

(i)     none

(ii)    1

(iii)   2

(iv)    3

(v)     More than 3

9) How long is your Vacation?

(i)     Less then one week

(ii)    2 weeks

(iii)   3 weeks

(iv)    more than 3weeks

10) Are they any infants travelling with you?

(i)     Yes

(ii)    No

11) Do you want a Vacation by Sea Shore?

(i)     Yes

(ii)    No

12) Would you like to hike during your Vacation?

(i)     Yes

(ii)    No

13) Do you want Casinos at your Vacation Place?

    (i)      Yes

    (ii)    No


14) Would you like to have an Option tour during your Vacation?

    (i)      Yes

    (ii)    No

    (iii)   Depends

## A.4   Rank Questionnaire

1) Rank the first form in a scale of 1 to 5. 5-best 1- worst

    (i)     1

    (ii)    2

    (iii)   3

    (iv)   4

    (v)    5

2) Rank the first form in a scale of 1 to 5. 5-best 1- worst

    (i)     1

    (ii)    2

    (iii)   3

    (iv)   4

    (v)    5

3) Rank the first form in a scale of 1 to 5. 5-best 1- worst

    (i)     1

    (ii)    2

    (iii)   3

    (iv)   4

    (v)    5

4) How many forms have you filled so far on the web(approx)

    (i)     Less Then 100

    (ii)    100-200

    (iii)   200-300

(iv)    More Then 300

# Appendix B

## B.1 Subject1

### Form1

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Single Page | 97 | 14 | 2 |

### Form2

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Next/Prev | 135 | 14 | 3 |

### Form3

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Tab | 83 | 15 | 5 |

## B.2 Subject2

### Form1

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Single Page | 102 | 14 | 3 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Next/Prev | 123 | 14 | 3 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Tab | 85 | 14 | 4 |

## B.3    Subject3

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Single Page | 92 | 14 | 3 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Next/Prev | 80 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Tab | 71 | 15 | 1 |

## B.4    Subject4

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Next/Prev | 105 | 15 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Tab | 92 | 16 | 5 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Single Page | 104 | 16 | 3 |

## B.5    Subject5

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Next/Prev | 67 | 16 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Tab | 71 | 16 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Single Page | 91 | 14 | 3 |

## B.6 Subject6

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Next/Prev | 54 | 15 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Tab | 66 | 15 | 5 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Single Page | 89 | 17 | 5 |

## B.7 Subject7

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Tab | 63 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Single Page | 61 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Next/Prev | 70 | 17 | 2 |

## B.8   Subject8

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Tab | 101 | 15 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Single Page | 117 | 14 | 5 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Next/Prev | 146 | 15 | 4 |

## B.9 Subject9

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Tab | 124 | 16 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Single Page | 97 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Next/Prev | 87 | 14 | 5 |

## B.10 Subject10

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Single Page | 126 | 14 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Next/Prev | 83 | 17 | 5 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Tab | 109 | 14 | 5 |

## B.11  Subject11

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Single Page | 107 | 14 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Next/Prev | 88 | 14 | 2 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Tab | 110 | 14 | 3 |

## B.12  Subject12

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Single Page | 88 | 15 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Next/Prev | 62 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Tab | 112 | 14 | 2 |

## B.13  Subject13

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Next/Prev | 55 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Tab | 73 | 14 | 1 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Single Page | 88 | 14 | 3 |

## B.14  Subject14

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Next/Prev | 126 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Tab | 117 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Single Page | 134 | 14 | 1 |

## B.15  Subject15

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Next/Prev | 74 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Tab | 66 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Single Page | 64 | 14 | 4 |

## B.16  Subject16

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Tab | 102 | 14 | 3 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Single Page | 62 | 15 | 3 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Next/Prev | 93 | 20 | 2 |

## B.17  Subject17

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Tab | 89 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Single Page | 62 | 15 | 3 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Next/Prev | 64 | 17 | 4 |

## B.18  Subject18

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | DropDownList | Tab | 88 | 14 | 2 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Single Page | 48 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | Radio Button | Next/Prev | 57 | 14 | 5 |

## B.19  Subject19

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Single Page | 96 | 14 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Next/Prev | 148 | 15 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Tab | 68 | 14 | 1 |

## B.20  Subject20

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Single Page | 90 | 15 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Next/Prev | 147 | 14 | 3 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Tab | 71 | 14 | 4 |

## B.21  Subject21

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | List Box | Single Page | 74 | 15 | 3 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Next/Prev | 107 | 14 | 3 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | DropDownList | Tab | 74 | 14 | 4 |

## B.22  Subject22

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Next/Prev | 78 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Tab | 92 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Single Page | 156 | 16 | 5 |

## B.23  Subject23

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Next/Prev | 71 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Tab | 80 | 14 | 4 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Single Page | 90 | 15 | 4 |

## B.24  Subject24

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | List Box | Next/Prev | 49 | 15 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Tab | 67 | 15 | 5 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | Radio Button | Single Page | 62 | 17 | 4 |

## B.25  Subject25

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Tab | 147 | 14 | 3 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Single Page | 101 | 14 | 3 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Next/Prev | 111 | 14 | 1 |

## B.26  Subject26

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Tab | 118 | 14 | 4 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Single Page | 103 | 15 | 3 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Next/Prev | 80 | 14 | 3 |

## B.27  Subject27

**Form1**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Health | List Box | Tab | 134 | 14 | 5 |

**Form2**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Vacation | Radio Button | Single Page | 103 | 14 | 5 |

**Form3**

| Questionnaire | Display Type | Navigation Type | Time (sec) | Clicks | Rank |
|---|---|---|---|---|---|
| Credit | DropDownList | Next/Prev | 111 | 14 | 4 |