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ECE 309

Project 1: Smiles and Leniency Engineering Experiment

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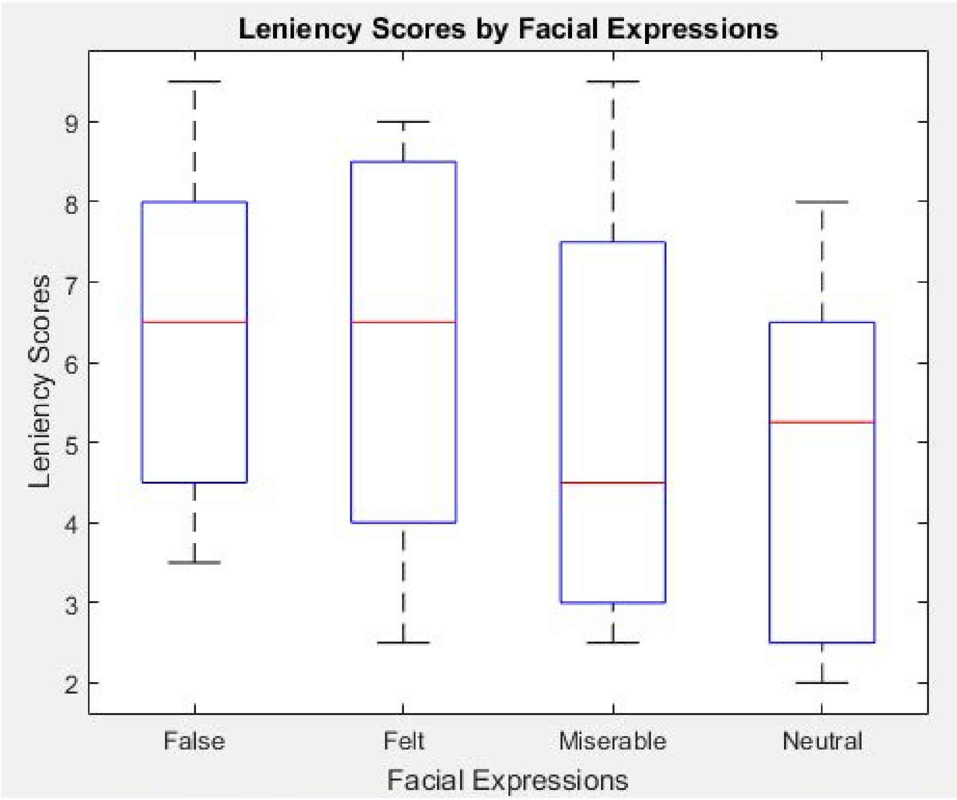
III. Comparative Boxplots for the Experimental Data:

1a.

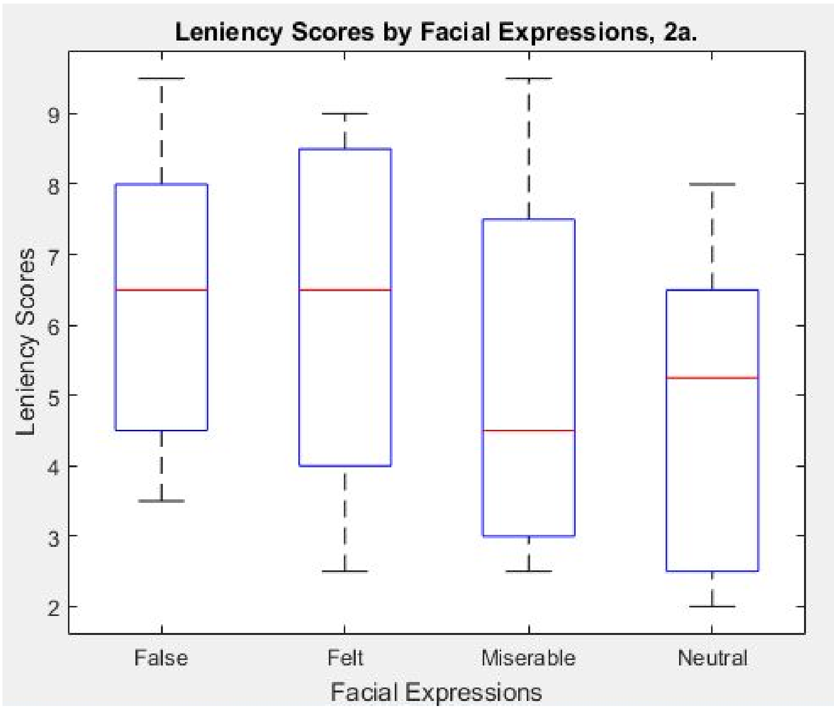


1b.

```
Command Window
New to MATLAB? See resources for Getting Started.

>> table_1b
table_1b =
    '  '                     'False'    'Felt'    'Miserable'    'Neutral'
    'Median'                 [ 6.50]    [6.50]    [      4.50]    [   5.25]
    'Mode'                   [ 6.50]    [4.50]    [      3.00]    [   2.00]
    'Mean'                   [ 6.39]    [6.02]    [      5.44]    [   4.87]
    'Standard Deviation'     [ 1.95]    [2.34]    [      2.29]    [   2.06]
    'Min'                    [ 3.50]    [2.50]    [      2.50]    [   2.00]
    '1st Quartile'           [ 4.50]    [4.00]    [      3.00]    [   2.50]
    '3rd Quartile'           [ 8.00]    [8.50]    [      7.50]    [   6.50]
    'Max'                    [ 9.50]    [9.00]    [      9.50]    [   8.00]
fx >>
```

2a.



2b.

Since we took care of data that could not have possibly occurred with NaN in Section II, the rest of our data were within Q1-1*(IQR) < Data <Q3 + 1*(IQR). Thus, whether we made our whisker length the default 1.5*(IQR) or the modified length 1*(IQR), our data did not have any outliers.

<u>IV. Specific Descriptive Statistics for the Experimental Data:</u>

1.

```
Command Window
New to MATLAB? See resources for Getting Started.

>> central_tendency
central_tendency =
    'Mean'                [6.39]    [6.02]    [5.44]    [4.87]
    '10% Trimmed Mean'    [6.38]    [6.05]    [6.05]    [6.05]
    'Median'              [6.50]    [6.50]    [4.50]    [5.25]
    'Mode'                [6.50]    [4.50]    [3.00]    [2.00]
>> spread
spread =
    'Range'       [6.00]    [6.50]    [7.00]    [6.00]
    'Variance'    [3.81]    [5.48]    [5.26]    [4.25]
    'IQR'         [3.50]    [4.50]    [4.50]    [4.00]
fx >>
```

2

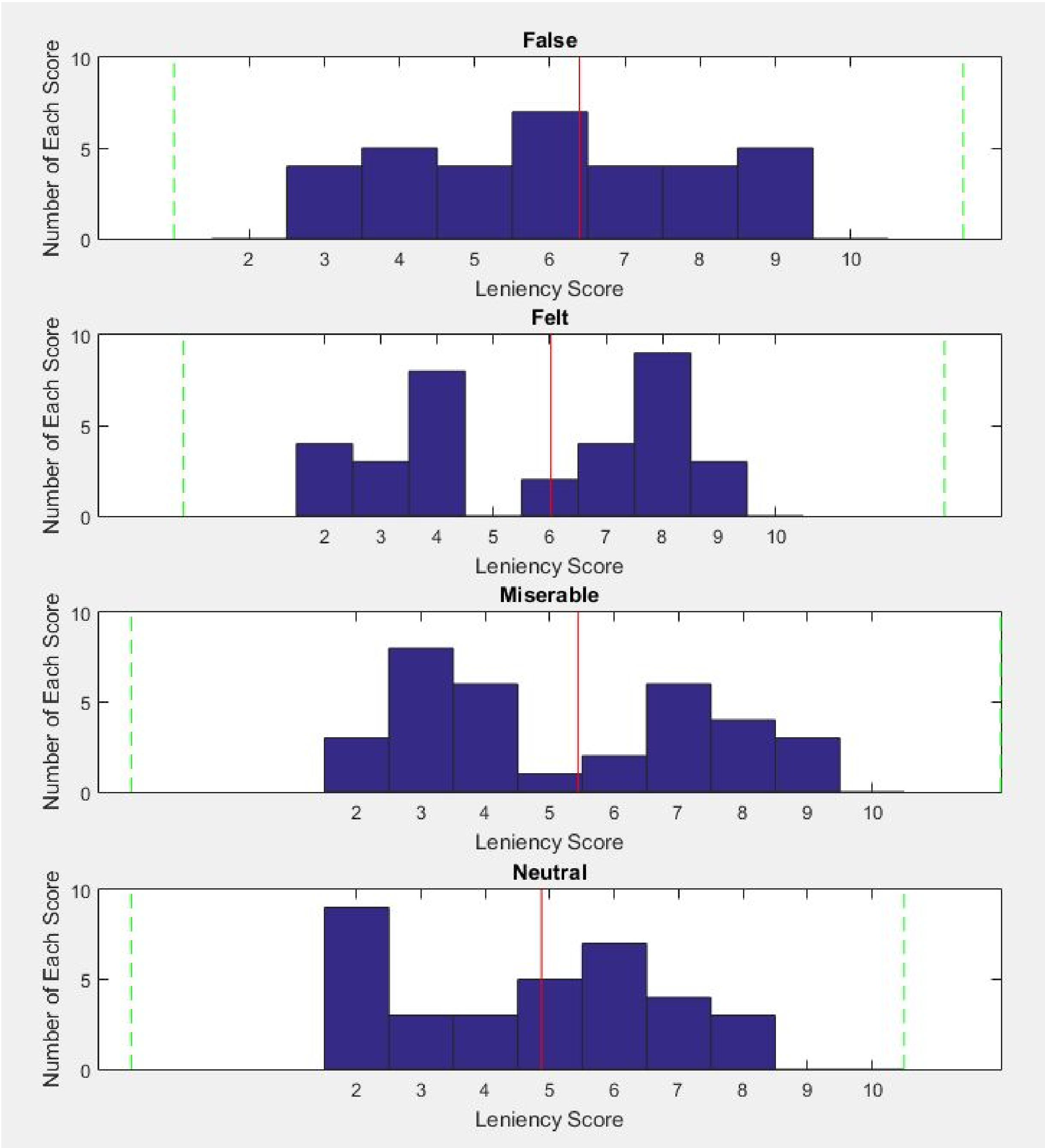
```
Command Window
New to MATLAB? See resources for Getting Started.

>> table_IV_2
table_IV_2 =
                        []    'False'    'Felt'    'Miserable'    'Neutral'
    'Mean'                  [ 6.39]    [6.02]    [      5.44]    [   4.87]
    '10% Trimmed Mean'      [ 6.38]    [6.05]    [      6.05]    [   6.05]
    'Median'                [ 6.50]    [6.50]    [      4.50]    [   5.25]
    'Mode'                  [ 6.50]    [4.50]    [      3.00]    [   2.00]
    'Range'                 [ 6.00]    [6.50]    [      7.00]    [   6.00]
    'Variance'              [ 3.81]    [5.48]    [      5.26]    [   4.25]
    'IQR'                   [ 3.50]    [4.50]    [      4.50]    [   4.00]
fx >>
```

3.

The medians, ranges, and interquartile range obtained in the table from Section IV number 2 matched the values we can observe from the boxplots. The means, mode, variance cannot be compared just by observation, but with the data we have, we can calculate those values by hand and get the same values.

V. Histograms for the Experimental Data



Command Window

New to MATLAB? See resources for Getting Started.

```
>> relative_statistics
relative_statistics =
    ''                       'False'     'Felt'      'Miserable'      'Neutral'
    'Q1'                     [ 4.50]     [ 4.00]     [      3.00]     [   2.50]
    'Median'                 [ 6.50]     [ 6.50]     [      4.50]     [   5.25]
    'Q3'                     [ 8.00]     [ 8.50]     [      7.50]     [   6.50]
    'IQR'                    [ 3.50]     [ 4.50]     [      4.50]     [   4.00]
    '90th Percentile'        [ 9.10]     [ 8.60]     [      8.60]     [   7.55]
    'Z-score of Max'         [ 1.59]     [ 1.28]     [      1.77]     [   1.52]
    'Z-score of Min'         [-1.48]     [-1.50]     [     -1.28]     [  -1.39]
fx >>
```

<u>Conclusion:</u>

For any values less than 0 and greater than 10, I replaced them with NaN. Even though it was tempting to replace -7 with 7 and 30 with 3, making those changes is biased because I know what other people in the specific group gave for their leniency scores. In that group of data with the 30, I saw a lot of small numbers that made me believe that the person added a zero on accident, but to refrain from including any bias into the data, I made 30 NaN instead.

From all of the techniques used in this project, the various statistics obtained from one technique matched closely to the statistics obtained from another technique. None of the data from the tables seemed unreasonable since we modified the given data to replace all unreasonable values with NaN.

The four types of smiles affected the judgment in possible wrongdoing cases. A simple neutral smile gave the worse leniency score. In the histogram, we can see there are many values on the low side of the neutral smile. The location where the IQR is located on the boxplot is lower than the other smile groups for the neutral response. From the histogram, we can see a split in the leniency score of the felt smile which means that people either had a good response or a bad response instead of neutral responses to seeing that smile. Similar to the felt smile, a miserable smile also had results that showed the extremes of disliking or liking the image, though some responses to the miserable smile was also average. The responses to the false smile were the closest to neutral with people giving out scores evenly from bad to average to good. The histogram for the false smile had a normal bell curve.

Appendix

'proj1.m'

```
clc
clear
format compact,format bank
load('columns.mat')

% Section III.
% 1a.
figure
boxplot([False, Felt, Miserable, Neutral], 'labels', {'False', 'Felt', 'Miserable', 'Neutral'})
title('Leniency Scores by Facial Expressions, 1a.')
ylabel('Leniency Scores')
xlabel('Facial Expressions')

% 1b.
table_1b = cell(9,5);
groups = {'False' 'Felt' 'Miserable' 'Neutral'};
y = {''; 'Median'; 'Mode' ;'Mean'; 'Standard Deviation' ;'Min'; '1st Quartile'; '3rd Quartile' ;'Max'};
medians = {nanmedian(sort(False)) nanmedian(sort(Felt)) nanmedian(sort(Miserable))
median(sort(Neutral))};
modes = {mode(False) mode(Felt) mode(Miserable) mode(Neutral)};
means = {nanmean(False) nanmean(Felt) nanmean(Miserable) nanmean(Neutral)};
stds = {nanstd(False) nanstd(Felt) nanstd(Miserable) nanstd(Neutral)};
mins = {min(False) min(Felt) min(Miserable) min(Neutral)};
firstq = {quantile(False,.25) quantile(Felt,.25) quantile(Miserable,.25) quantile(Neutral,.25)};
thirdq = {quantile(False,.75) quantile(Felt,.75) quantile(Miserable,.75) quantile(Neutral,.75)};
maxes = {max(False) max(Felt) max(Miserable) max(Neutral)};

table_1b(1,2:5) = groups;
table_1b(1:9,1) = y;
table_1b(2,2:5) = medians;
table_1b(3,2:5) = modes;
table_1b(4,2:5) = means;
table_1b(5,2:5) = stds;
table_1b(6,2:5) = mins;
table_1b(7,2:5) = firstq;
table_1b(8,2:5) = thirdq;
table_1b(9,2:5) = maxes;


% 2a.
figure
boxplot([False, Felt, Miserable, Neutral], ...
    'labels', {'False', 'Felt', 'Miserable', 'Neutral'}, ...
    'whisker', 1 )
title('Leniency Scores by Facial Expressions, 2a.')
ylabel('Leniency Scores')
```

```
xlabel('Facial Expressions')

% Section IV.
% 1
means = {nanmean(False) nanmean(Felt) nanmean(Miserable) nanmean(Neutral)};
trimmed_mean10 = {trimmean(False,10) trimmean(Felt,10) trimmean(Felt,10) trimmean(Felt,10)};
medians = {nanmedian(sort(False)) nanmedian(sort(Felt)) nanmedian(sort(Miserable))
median(sort(Neutral))};
modes = {mode(False) mode(Felt) mode(Miserable) mode(Neutral)};

ranges = {range(False) range(Felt) range(Miserable) range(Neutral)};
variances = {nanvar(False) nanvar(Felt) nanvar(Miserable) nanvar(Neutral)};
IQRs = {iqr(False) iqr(Felt) iqr(Miserable) iqr(Neutral)};

% 2
ct_labels = {'Mean'; '10% Trimmed Mean'; 'Median'; 'Mode'};
central_tendency = cell(4,5);
central_tendency(1:4,2:5) = [means; trimmed_mean10; medians; modes];
central_tendency(1:4,1) = ct_labels;

spread_labels = {'Range'; 'Variance'; 'IQR'};
spread = cell(3,5);
spread(1:3,1) = spread_labels;
spread(1,2:5) = ranges;
spread(2,2:5) = variances;
spread(3,2:5) = IQRs;

table_IV_2 = cell(8,5);
table_IV_2(1,1) = {''};
table_IV_2(1,2:5) = groups;
table_IV_2(2:5,1:5) = central_tendency;
table_IV_2(6:8,1:5) = spread;

% Section V.
figure
center = 2:10;

subplot(4,1,1); hist(False,center); title('False');
xlabel('Leniency Score'); ylabel('Number of Each Score');

hold on
plot([nanmean(False),nanmean(False)],ylim,'r')
plot([quantile(False,.25)-iqr(False),quantile(False,.25)-iqr(False)],ylim,'g--')
plot([quantile(False,.75)+iqr(False),quantile(False,.75)+iqr(False)],ylim,'g--')
hold off

subplot(4,1,2); hist(Felt,center); title('Felt');
xlabel('Leniency Score'); ylabel('Number of Each Score');
```

```
hold on
plot([nanmean(Felt),nanmean(Felt)],ylim,'r')
plot([quantile(Felt,.25)-iqr(Felt),quantile(Felt,.25)-iqr(Felt)],ylim,'g--')
plot([quantile(Felt,.75)+iqr(Felt),quantile(Felt,.75)+iqr(Felt)],ylim,'g--')
hold off

subplot(4,1,3); hist(Miserable,center); title('Miserable');
xlabel('Leniency Score'); ylabel('Number of Each Score');

hold on
plot([nanmean(Miserable),nanmean(Miserable)],ylim,'r')
plot([quantile(Miserable,.25)-iqr(Miserable),quantile(Miserable,.25)-iqr(Miserable)],ylim,'g--')
plot([quantile(Miserable,.75)+iqr(Miserable),quantile(Miserable,.75)+iqr(Miserable)],ylim,'g--')
hold off

subplot(4,1,4); hist(Neutral,center); title('Neutral');
xlabel('Leniency Score'); ylabel('Number of Each Score');

hold on
plot([nanmean(Neutral),nanmean(Neutral)],ylim,'r')
plot([quantile(Neutral,.25)-iqr(Neutral),quantile(Neutral,.25)-iqr(Neutral)],ylim,'g--')
plot([quantile(Neutral,.75)+iqr(Neutral),quantile(Neutral,.75)+iqr(Neutral)],ylim,'g--')
hold off

% Section VI.
relative_statistics = cell(8,5);
rs_labels = {'';'Q1';'Median';'Q3';'IQR';'90th Percentile';'Z-score of Max';'Z-score of Min'};
q90 = {quantile(False,.9) quantile(Felt,.9) quantile(Miserable,.9) quantile(Neutral,.9)};
zscore_max = {(max(False)-nanmean(False))/nanstd(False) ...
        (max(Felt)-nanmean(Felt))/nanstd(Felt) ...
        (max(Miserable)-nanmean(Miserable))/nanstd(Miserable) ...
        (max(Neutral)-nanmean(Neutral))/nanstd(Neutral) };

zscore_min = {(min(False)-nanmean(False))/nanstd(False) ...
        (min(Felt)-nanmean(Felt))/nanstd(Felt) ...
        (min(Miserable)-nanmean(Miserable))/nanstd(Miserable) ...
        (min(Neutral)-nanmean(Neutral))/nanstd(Neutral) };

relative_statistics(1:8,1) = rs_labels;
relative_statistics(1,2:5) = groups;
relative_statistics(2,2:5) = firstq;
relative_statistics(3,2:5) = medians;
relative_statistics(4,2:5) = thirdq;
relative_statistics(5,2:5) = IQRs;
relative_statistics(6,2:5) = q90;
relative_statistics(7,2:5) = zscore_max;
relative_statistics(8,2:5) = zscore_min;
```