Name: _____ Business Data Analysis
Date: 201-316-VA

In Class Exercise #4: Measures of Spread & Mini Review

1. **Flamethrowers**

Anti-pervert flamethrowers went on sale in China last year[1]. The devices are small enough to be concealed in a handbag, yet serious enough to pack a punch and cause permanent disfigurement. Designed to help women fend off unwanted advances from men, some models can shoot flames up to half a metre long and at temperatures of 1800°C. Police have warned that the devices are illegal, but the company that produces them says that they're at least, non-lethal.

(a) Ten flamethrowers were randomly selected from a batch of 100 and the temperature of the flames produced by these (in hundreds of degrees Celcius) are shown below.

10 11 11 12 13 13 13 15 15 17

i. Calculate the average temperature of the flame emitted by these flame throwers.

$$\overline{x} = \frac{\sum x}{n} = \frac{10+11+11+12+13+13+15+15+17}{10} = \frac{130}{10} = 13$$

Solution: The average is 1300°C

ii. Calculate the appropriate **variance** for the data above, and be sure to include the units of measure.

x	x^2
10	100
11	121
11	121
12	144
13	169
13	169
13	169
15	225
15	225
17	289
130	**1732**

$$s^2 = \frac{1}{n-1}\left[\sum x^2 - \frac{(\sum x)^2}{n}\right] = \frac{1}{10-1}\left[1732 - \frac{(130)^2}{10}\right] = 4.6667°\text{C}^2$$

Solution: The sample variance is $4.6667°\text{C}^2$

iii. Calculate the appropriate **standard deviation**, for the temperature of the flames emitted by the flamethrowers and include the units of measure.

$$s = \sqrt{s^2} = \sqrt{4.6667} = 2.1602°\text{C}$$

Solution: The sample standard deviation is 2.1602°C

[1] https://www.telegraph.co.uk/news/2017/07/18/anti-pervert-flame-throwers-sale-china/

(b) To protect themselves from perverts, Chinese women can also buy rings that function as spikes, knives disguised as credit cards, and daggers hidden in key rings. A group of women were asked how much they had spent on anti-pervert devices in the last year. The results are below rounded to the nearest dollar.

Amount Spent ($)	**Number of Women**	m	fm	fm^2
[0, 10)	15	5	75	375
[10, 20)	26	15	390	350
[20, 30)	36	25	900	22500
[30, 40)	27	35	945	33075
[40, 50)	16	45	720	32400
	120		**3030**	**94200**

i. Calculate the average amount of money spent on self defense devices by this group of women.

$$\overline{x} = \frac{\sum fm}{\sum f} = \frac{3030}{120} = \$25.25$$

Solution: The average amount spent by these women is $25.25

ii. Calculate the standard deviation.

$$s^2 = \frac{1}{n-1}\left[\sum fm^2 - \frac{(\sum fm)^2}{n}\right] = \frac{1}{120-1}\left[94200 - \frac{(3030)^2}{120}\right] = \$^2\, 148.6765$$

$$s = \sqrt{s^2} = \sqrt{148.665} = \$12.1933$$

Solution: the standard deviation for this sample is $12.19

2. **Blame it on The Ambien**

After posting a series of racist tweets, Rosanne Barr's sitcom was cancelled by ABC. The actress blamed the sleep medication, Ambien, for her actions - but the company which makes the sedative were quick to point out that none of its products cause racism as a side-effect[2]. Barr did not comment on whether her 10 year history of racially charged tweets were also written under the influence of Ambien.

For several patients taking Ambien, the number of side-effects that they experienced while using the drug is presented below.

Number of Patients	**Number of Side-Effects**		
f	x	fx	fx^2
18	0	0	0
48	1	48	48
52	2	104	208
46	3	138	414
36	4	144	576
200		**434**	**1246**

(a) Calculate the average number of side-effects experienced by this group of people taking Ambien.

$$\overline{x} = \frac{\sum fx}{n} = \frac{434}{200} = 2.17$$

Solution: Average number of side effects is 2.17.

(b) Calculate variance for the given data, and include units in your answer.

$$s^2 = \frac{1}{n-1}\left[\sum fx^2 - \frac{(\sum fx)^2}{n}\right] = \frac{1}{200-1}\left[1246 - \frac{(434)^2}{200}\right] = 1.5287 \text{ side effects}^2$$

Solution: The sample variance is 1.5287 side effects^2

[2]https://www.theguardian.com/culture/2018/may/30/roseanne-ambien-racism-tweet-side-effect-response-sanofi

(c) What is the standard deviation?

$$s = \sqrt{s^2} = \sqrt{1.5287} = 1.2364 \text{ side effects}$$

Solution: The sample standard deviation is 1.2364 side effects.

(d) Suppose that eight people were recruited to test a new sleeping aid. The number of side-effect experienced by these eight are shown below:

$$3 \quad 2 \quad 1 \quad 2 \quad 4 \quad 2 \quad 5 \quad 5$$

i. Calculate the average number of side-effects for this group.

$$\mu = \frac{\sum x}{N} = \frac{3+2+1+2+4+2+5+5}{8} = \frac{24}{8} = 3$$

Solution: The average number of side effects is 3

ii. Calculate the appropriate variance for the given data.

x	x^2
3	9
2	4
1	1
2	4
4	16
2	4
5	25
5	25
24	**88**

$$\sigma^2 = \frac{1}{N}\left[\sum x^2 - \frac{(\sum x)^2}{N}\right] = \frac{1}{8}\left[88 - \frac{(24)^2}{8}\right] = 2$$

Solution: The population variance is 2 side effects^2

iii. Calculate the standard deviation.

$$\sigma = \sqrt{\sigma^2} = \sqrt{2} = 1.4142$$

Solution: The population standard deviation is 1.4142 side effects

3. **AlphaGo**

One way or another, 2017 was a bad year for humankind. We were beaten by Artifical Intelligence at no-limit Texas hold'em poker, Dota 2, and Ms.Pacman[3]. By far the most crushing defeat came when AlphaGo, an AI developed by Google's DeepMind Technologies, beat world champion, Kie Jie, in a three game-match of Go. The ancient board game is so complex, that it was considered to be one of the lasts games that humans could beat machines at. AlphaGo won 3 - 0, and retired immediately afterwards so that researchers at DeepMind could continue work in other areas.

(a) To train AlphaGo, developers simulated 80 games, and the number of minutes that it took for the AI to win the match is shown below.

60	62	62	68	69	72	73	76	76	79	81	84	85	85	88	89	90
91	91	93	93	94	95	98	99	99	99	100	100	101	103	104	104	108
115	116	117	123	124	125	128	130	132	133	134	134	134	136	137	144	145
145	146	146	146	146	147	147	148	149	150	150	151	153	153	154	155	155
157	158	159	159	159	160	162	162	165	165	165	165					

Using **seven** classes, complete the following table:

$$CW = \frac{HV - LV}{6} = \frac{165 - 60}{7} = 15 \quad \Rightarrow \quad CW = 16$$

Time (min.)	**Class Bound**	**Freq.**	**Rel. Freq** (%)	**LTCF**	**LTCF** (%)
60 – 75	59.5 – 75.5	7	8.75	7	8.75
76 – 91	75.5 – 91.5	12	15.00	19	23.75
92 – 107	91.5 – 107.5	14	17.50	33	41.25
108 – 123	107.5 – 123.5	5	6.25	38	47.50
124 – 139	123.5 – 139.5	11	13.75	49	61.25
140 – 155	139.5 – 155.5	19	23.75	68	85.00
156 – 171	155.5 – 171.5	12	15.00	80	100.00

(b) The most frequently occurring category is **140 – 155**, and contains **23.75**% of the data.

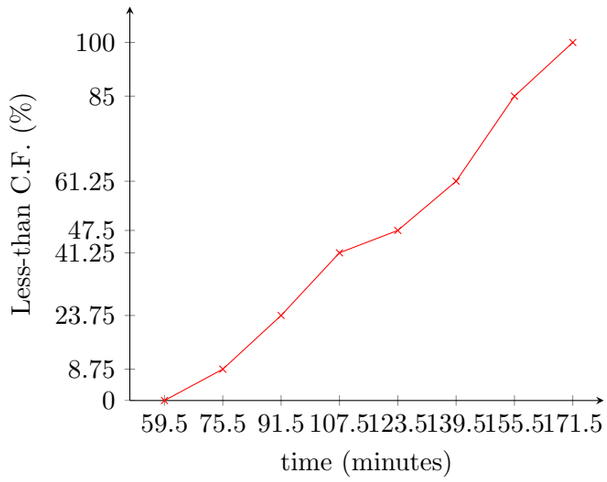
(c) The least frequently occurring category is **108 – 125**, and contains **5** pieces of data.

(d) How many games did AlphaGo win in 107 minutes or less? **33**

(e) How many games did the AI win in 91 minutes or less? **19**

(f) It took AlphaGo at most 155 minutes to win **85**% of the games.

(g) Sketch an ogive for LTCF (%). Be sure to label your axes.



[3]https://newatlas.com/ai-2017-beating-humans-games/52741/

4. **Private Jet**

A US televangelist has asked his followers to help him buy a new private jet so he can spread the Gospel faster and because 'Jesus wouldn't be riding a donkey'. Jesse Duplantis said that God told him to buy a Falcon 7X for $54 million - and this will be his fourth one. Flying in a private jet seems to be more preferable than travelling on standard commercial flights for tv evangelists. In 2015, Mr.Duplantis appeared in a video with another preacher, Mr.Copeland, in which the latter described his experience on board a commercial flight as 'being in a tube filled with demons'[4].

Sixty followers of Mr.Duplantis were asked how much money they had donated to the new jet. Below are their responses rounded to the nearest dollar.

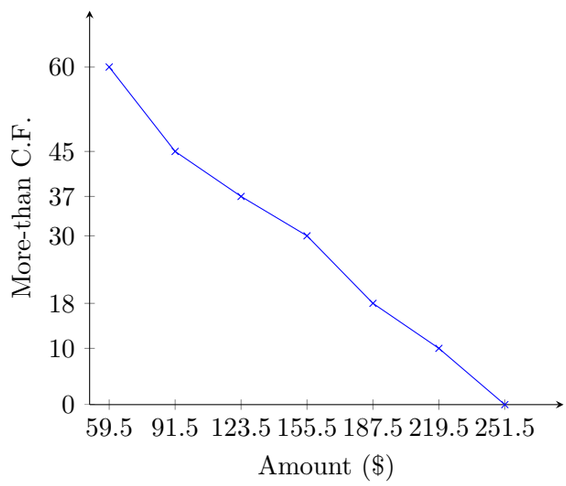
60	65	65	70	70	70	75	75	75	80	80	80	85	85	90
95	95	99	100	100	110	110	115	130	130	130	130	135	140	145
160	165	165	165	165	175	175	175	180	180	185	185	190	195	195
199	200	210	215	219	225	230	230	230	235	235	240	245	245	250

(a) Using six classes, complete the table below:

$$CW = \frac{HV - LV}{6} = \frac{250 - 60}{6} = 31.6 \quad \Rightarrow \quad CW = 32$$

Amount ($)	**Class Bound**	**Freq.**	**Rel. Freq** (%)	**MTCF**	**MTCF** (%)
60 – 91	59.5 – 91.5	15	25.00	60	100.00
92 – 123	91.5 – 123.5	8	13.33	45	75.00
124 – 155	123.5 – 155.5	7	11.67	37	61.67
156 – 187	155.5 – 187.5	12	20.00	30	50.00
188 – 219	187.5 – 219.5	8	13.33	18	30.00
220 – 251	219.5 – 251.5	10	16.67	10	16.67

(b) Sketch the ogive for the MTCF frequencies. Label your axes.



(c) How many people made a donation of $156 or more? **30**

(d) What percentage of followers made a donation of $220 or more? **16.67**%

(e) The first category contains **15** donors and accounts for 25.00% of the sample.

(f) The number of followers who donated at least $92 to the private jet is: **45**

(g) What is the range for the data above? $**190**

[4]https://www.bbc.com/news/world-us-canada-44305873