**Inferential Statistics**

Instructions:

Please share your answers filled inline in the word document. Submit Python code and R code files wherever applicable.

Insights should be drawn from the plots about the data such as, is data normally distributed/not, outliers, measures like mean, median, mode, variance, std. deviation

Please ensure you update all the details:

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**Topic: Basic Statistics**

**Problem Statements:**

Q1) Three Coins are tossed, find the probability that two heads and one tail are obtained?

Solution:

We know that,

**Probability of an event (E) = Number of favourable outcomes / Total number of outcomes**

Let, H = Heads, T = Tails

Possible outcomes:

(H, H, H), (H, H, T), (H, T, H), (H, T, T), (T, H, H), (T, H, T), (T, T, H), (T, T, T)

Total number of outcomes = 8

Number of outcomes that gives two heads and one tail = 3

i.e., (H, H, T), (H, T, H), (T, H, H)

Thus, number of favourable outcomes = 3

Probability of getting two heads and one tail = Number of favourable outcomes / Total number of outcomes

**the probability of getting two heads and one tail on tossing three coins at once is equal to 3/8**

Q2) Two Dice are rolled, find the probability that sum is

1. Equal to 1
2. Less than or equal to 4
3. Sum is divisible by 2 and 3

Solution:

**Assumptions**

1. The dice are “fair “, that is, not biased in any manner.
2. The dice are both six-sided dice, that is both have 6 faces, with each face on each dice, showing one of the numbers, 1 to 6, with no number repeated on the same dice.

Analysis

With two dice, there are (6) \* (6) = (36) possible combinations of numbers.

The minimum sum possible for the two dice thrown is (1, 1) = a sum of (2)

The maximum sum possible for the two dice thrown is (6, 6) = a sum of (12).

1. **Equal to 1**

Solution:

The minimum possible sum is (1, 1) = (2).

Therefore P (1) = (0) / (36) = 0

1. **Less than or equal to 4**

Solution:

Less than or equal to 4 can be obtained with the combination of (1,1), (1,2), (1,3), (2,1), (3,1), (2,2) = (6)

Therefore P (x ≤ 4) = (6) / (36) = 1/6

1. **Sum is divisible by 2 and 3**

Solution:

Total number of possible outcomes = 36

Favourable outcomes = sum is divisible by 2 and 3

Sum should be divisible by both 2 and 3

Favourable outcomes = (1, 5), (3, 3), (4, 2), (5, 1), (6, 6)

Therefore,

Number of favourable outcomes = 5

Therefore, P = (5) / (36) = 5/36

Q3) A bag contains 2 red, 3 green and 2 blue balls. Two balls are drawn at random. What is the probability that none of the balls drawn is blue?

Solution:

Total number of balls = (2 + 3 + 2) = 7  
Let S be the sample space.  
Then, n(S) = Number of ways of drawing 2 balls out of 7  
=7C2​  
= (7×6)​ / 2  
=21  
Let E = Event of drawing 2 balls, none of which is blue.  
∴n(E)= Number of ways of drawing 2 balls out of (2 + 3) balls.  
=5C2​  
= (5×4)​ / 2  
=10  
∴P(E)= n(E)​/ n(S) = 10/21

Q4) Calculate the Expected number of candies for a randomly selected child:

Below are the probabilities of count of candies for children (ignoring the nature of the child-Generalized view)

i. Child A – probability of having 1 candy is 0.015

ii. Child B – probability of having 4 candies is 0.2

|  |  |  |
| --- | --- | --- |
| CHILD | Candies count | Probability |
| A | 1 | 0.015 |
| B | 4 | 0.20 |
| C | 3 | 0.65 |
| D | 5 | 0.005 |
| E | 6 | 0.01 |
| F | 2 | 0.12 |

Solution:

Expected number of candies for a randomly selected child

= 1 \* 0.015 + 4\*0.20 + 3 \*0.65 + 5\*0.005 + 6 \*0.01 + 2 \* 0.12

= 0.015 + 0.8 + 1.95 + 0.025 + 0.06 + 0.24

= 3.090

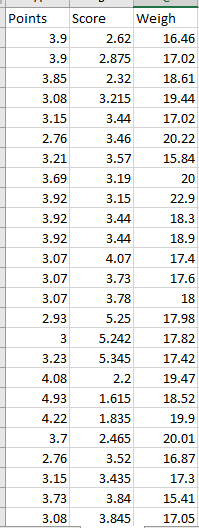
= 3.09

Expected number of candies for a randomly selected child = 3.09

Q5) Calculate Mean, Median, Mode, Variance, Standard Deviation, Range & comment about the values / draw inferences, for the given dataset

* For Points, Score, Weigh>

Find Mean, Median, Mode, Variance, Standard Deviation, and Range and comment about the values/ Draw some inferences.



Dataset: Refer to Hands-on Material in LMS - Data Types EDA assignment snap shot of dataset is given above.

Solution:

Solution is in R and Python codes attached along with the dataset. (inferentialStatsQ5.r & inferentialStatsQ5.py)

Q6) Calculate Expected Value for the problem below

1. The weights (X) of patients at a clinic (in pounds), are

108, 110, 123, 134, 135, 145, 167, 187, 199

Assume one of the patients is chosen at random. What is the Expected Value of the Weight of that patient?

Solution:

Expected Value = ∑ (probability \* Value)

 ∑ P(x). E(x)

there are 9 patients

Probability of selecting each patient = 1/9

Expected Value = (1/9) \*(108) + (1/9) \*110 + (1/9) \*123 + (1/9) \*134 + (1/9) \*135 + (1/9) \*145 + (1/9\*(167) + (1/9) \*187 + (1/9) \*199

= (1/9) (108 + 110 + 123 + 134 + 135 + 145 + 167 + 187 + 199)

= (1/9) (1308)

= 145.33

Expected Value of the Weight of that patient = 145.33

Q7) Look at the data given below. Plot the data, find the outliers and find out

**Hint:** [Use a plot which shows the data distribution, skewness along with the outliers; also use R/Python code to evaluate measures of centrality and spread]

|  |  |
| --- | --- |
| **Name of company** | **Measure X** |
| Allied Signal | 24.23% |
| Bankers Trust | 25.53% |
| General Mills | 25.41% |
| ITT Industries | 24.14% |
| J.P.Morgan & Co. | 29.62% |
| Lehman Brothers | 28.25% |
| Marriott | 25.81% |
| MCI | 24.39% |
| Merrill Lynch | 40.26% |
| Microsoft | 32.95% |
| Morgan Stanley | 91.36% |
| Sun Microsystems | 25.99% |
| Travelers | 39.42% |
| US Airways | 26.71% |
| Warner-Lambert | 35.00% |

Solution:

Solution is in R and Python codes attached along with the dataset. (inferentialStatsQ7.py & inferentialStatsQ7.r)

Q8) AT&T was running commercials in 1990 aimed at luring back customers who had switched to one of the other long-distance phone service providers. One such commercial shows a businessman trying to reach Phoenix and mistakenly getting Fiji, where a half-naked native on a beach responds incomprehensibly in Polynesian. When asked about this advertisement, AT&T admitted that the portrayed incident did not actually take place but added that this was an enactment of something that “could happen.” Suppose that one in 200 long-distance telephone calls is misdirected.

What is the probability that at least one in five attempted telephone calls reaches the wrong number? (Assume independence of attempts.)

**Hint:** [Using Probability formula evaluate the probability of one call being wrong out of five attempted calls]

Solution:

one in 200 long-distance telephone calls is misdirected

probability of call misdirecting p = 1/200

Probability of call not Misdirecting = 1 - 1/200 = 199/200

Number of Calls = 5

P(x) = ⁿCₓpˣqⁿ⁻ˣ

n = 5

p = 1/200

q = 199/200

at least one in five attempted telephone calls reaches the wrong number

= 1 - none of the call reaches the wrong number

= 1 - P (0)

= 1   - ⁵C₀ (1/200) ⁰ (199/200) ⁵⁻⁰

= 1 - (199/200) ⁵

= 0.02475

probability that at least one in five attempted telephone calls reaches the wrong number = 0.02475

Q9) Returns on a certain business venture, to the nearest $1,000, are known to follow the following probability distribution

|  |  |
| --- | --- |
| X | P(x) |
| -2,000 | 0.1 |
| -1,000 | 0.1 |
| 0 | 0.2 |
| 1000 | 0.2 |
| 2000 | 0.3 |
| 3000 | 0.1 |

1. What is the most likely monetary outcome of the business venture?

**Hint:** [The outcome is most likely the expected returns of the venture]

Solution:

X = 2000, probability of 0.3 (Maximum)

1. Is the venture likely to be successful? Explain.

**Hint:** [Probability of % of venture being a successful one]

Solution:

p(x=1000) +p(x=2000) +p(x=3000) =0.6

sum of non-negative number is greater than 0.5 hence it will be successful.

1. What is the long-term average earning of business ventures of this kind? Explain.

**Hint:** [Here, the expected returns to the venture is considered as the

the required average]

Solution:

= (-2000\*0.1) +(-1000\*0.1) +(0\*0.2) +(1000\*0.2) +(2000 \*0.3) +(3000\*0.1) =800

Therefore, the long-term average earning for these types of ventures would be around $800

1. What is the good measure of the risk involved in a venture of this kind? Compute this measure.

**Hint:** [Risk here stems from the possible variability in the expected returns, therefore, name the risk measure for this venture]

Solution:

sd(ex$x)

=1870.829

var(ex$x)

=3500000

The large value of standard deviation of $1870 is considered along with the average returns of $800 indicates that this venture is highly risky.

**Hints:**

For each assignment, the solution should be submitted in the below format

1. Research and Perform all possible steps for obtaining solution.

2. For Statistics calculations, explanation of the solutions should be documented detail along with codes. Use the same word document to fill in your explanation

Must follow these guidelines:

2.1. Be thorough with the concepts of Probability, Central Limit Theorem and Perform the

calculation stepwise

2.2. For True/False Questions, or short answer type questions explanation is must.

2.3. R & Python code for Univariate Analysis (histogram, box plot, bar plots etc.) the data

distribution to be attached

3. All the codes (executable programs) should execute without errors

4. Code modularization should be followed

5. Each line of code should have comments explaining the logic and why you are using that function