

## Rules

- The number of items in a group  $k=N/n$
- Range =  $X_{\text{largest}} - X_{\text{smallest}}$
- Class interval (width) =  $\frac{\text{Range}}{\text{class number}}$
- Relative Frequency = Frequency / Total
- Cumulative Frequency = (Frequency / Total)\*100
- Cumulative Percentage = Cumulative Frequency \*100
- Median position =  $\frac{n+1}{2}$  in the ordered data
- Median Value =  $\begin{cases} \frac{n+1}{2} & \text{in the odd} \\ \frac{n}{2}, \frac{n}{2} + 1 & \text{in the even} \end{cases}$
- Sample Mean  $\bar{X} = \frac{\sum_{i=1}^n X_i}{n} = \frac{X_1+X_2+\dots+X_n}{n}$
- Population Mean,  $\mu = \frac{\sum_{i=1}^N X_i}{N} = \frac{X_1+X_2+\dots+X_N}{N}$
- Sample Variance  $S^2 = \frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}$
- Sample Standard deviation,  $S = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$
- Population Variance,  $\sigma^2 = \frac{\sum_{i=1}^N (X_i - \mu)^2}{N}$
- Population Standard deviation,  $\sigma = \sqrt{\frac{\sum_{i=1}^N (X_i - \mu)^2}{N}}$
- Coefficient of variation  $CV = \left(\frac{S}{\bar{X}}\right) \cdot 100\%$
- Z-score,  $Z = \frac{X - \bar{X}}{S}$
- First quartile position:  $Q_1 = (n+1)/4$  ranked value.
- Second quartile position:  $Q_2 = (n+1)/2$  ranked value.
- Third quartile position:  $Q_3 = 3(n+1)/4$  ranked value.
- IQR is  $Q_3 - Q_1$

- **Empirical Rule**

- One standard deviation ( $\mu \pm \sigma$ )
- Two standard deviations ( $\mu \pm 2\sigma$ )
- Three standard deviations ( $\mu \pm 3\sigma$ )

- The sample covariance,  $cov(X, Y) = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{n-1}$

- Sample coefficient of correlation,  $r = \frac{cov(X, Y)}{S_X S_Y}$

where,  $S_X = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$  and  $S_Y = \sqrt{\frac{\sum_{i=1}^n (Y_i - \bar{Y})^2}{n-1}}$

- probability of occurrence =  $\frac{X}{T} = \frac{\text{number of ways in which the event occurs}}{\text{total number of possible outcomes}}$

- $P(A \text{ and } B) = \frac{\text{number of outcomes satisfying } A \text{ and } B}{\text{total number of outcomes}}$

- A marginal probability

$$P(A) = P(A \text{ and } B_1) + P(A \text{ and } B_2) + \dots + P(A \text{ and } B_k)$$

- General addition rule  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

- Addition rule for mutually exclusive events

- $P(A \text{ or } B) = P(A) + P(B)$

- A conditional probability

- $P(A | B) = \frac{P(A \text{ and } B)}{P(B)}$ ,  $P(B | A) = \frac{P(A \text{ and } B)}{P(A)}$

- A conditional probability for independent events  $P(A | B) = P(A)$

- The General Multiplication Rule  $P(A \text{ and } B) = P(A | B) P(B)$

- Multiplication Rule for independent event

$$P(A \text{ and } B) = P(A)P(B)$$

- Marginal probability for event A:

$$P(A) = P(A | B_1)P(B_1) + P(A | B_2)P(B_2) + \dots + P(A | B_k)P(B_k)$$

- Bayes' Theorem

$$P(B_i | A) = \frac{P(A | B_i)P(B_i)}{P(A | B_1)P(B_1) + P(A | B_2)P(B_2) + \dots + P(A | B_k)P(B_k)}$$

- Counting rule 1: -The number of possible outcomes is equal to  $K^n$
- Counting Rule 2: -The number of possible outcomes is equal to  $(k_1)(k_2)(k_3)$
- Counting Rule 3: -The number of possible outcomes is  $n! = (n)(n - 1) \cdots (1)$
- Counting Rule 4 (Permutations): -The number of possible outcomes is  $nP_x = \frac{n!}{(n-x)!}$
- Counting Rule 5 (Combination): -The number of possible outcomes is  $nC_x = \frac{n!}{x!(n-x)!}$
- Expected Value (or mean) of a discrete variable  $\mu = E(X) = \sum_{i=1}^N x_i P(X = x_i)$
- Variance of a discrete variable,  $\sigma^2 = \sum_{i=1}^N [x_i - E(X)]^2 P(X = x_i)$
- Standard Deviation of a discrete variable.  $\sigma = \sqrt{\sigma^2} = \sqrt{\sum_{i=1}^N [x_i - E(X)]^2 P(X = x_i)}$
- Binomial Distribution Formula  $P(X=x | n, \pi) = \frac{n!}{x!(n-x)!} \pi^x (1 - \pi)^{n-x}$
- Binomial Mean:  $\mu = E(X) = n\pi$
- Binomial Variance and Standard Deviation:  $\sigma^2 = n\pi(1-\pi)$  ,  $\sigma = \sqrt{n\pi(1-\pi)}$
- Poisson Distribution Formula,  $P(X = x | \lambda) = \frac{e^{-\lambda} \lambda^x}{x!}$
- Poisson Mean:  $\mu = \lambda$
- Poisson Variance and Standard Deviation:  $\sigma^2 = \lambda$ ,  $\sigma = \sqrt{\lambda}$
- Convert to X units to z,  $X = \mu + Z\sigma$

$z$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

