Deck of cards
- **52** Cards total
- **4 Suits** (Clubs, Diamonds, Hearts, Spades)
- **2 Colors** (Red and Black)
- Each suit has: Ace, 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack, Queen, King
- Jack, Queen and King hold the value of 10
- Ace could either be 1 or 11

Sets
- Collection of elements; {5, 6, 8, 63, B, U, 7, 4}
- **Cannot** have repeat elements
- Intersect (∩ | **AND**)
- Union (U | **OR**)

Probability
- Theoretical (Most reliable)
  - Calculated from the start
- Experimental (2nd most reliable)
  - Run an experiment to find out
  - Bigger sample size = More accurate
- Subjective (Least reliable)
  - Based on instincts, prior experience not needed
  - E.g Stock trading
- Probability cannot be **negative**
- **100% chance** for something to happen
- Independent events **do not influence** each other
- **Mutually exclusive** or **disjoint events cannot** happen simultaneously
- Independent and disjoint are **not the same**
- **Marginal probability: P(A)**
  - Not reliant on other events
- **Conditional/Posterior probability: P(A|B)**
  - Dependent on other events
- **Joint probability: P(A∩B)**

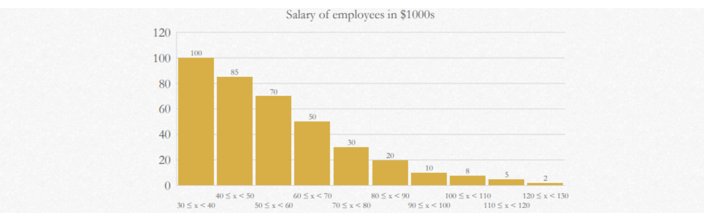
Terms
- True Positive (TP): Model **correctly** predicts + outcome
- True Negative (TN): Model **correctly** predicts - outcome
- False Positive (FP): Model **incorrectly** predicts + outcome
- False Negative (FN): Model **incorrectly** predicts - outcome
- True Positive (TP) + False Negative (FN) = 1
- True Negative (TN) + False Positive (FP) = 1

Central Tendency
- **Mean**/Average (**μ**) is sensitive to outliers
- **Median** (**center value** in ascending order sets) is not affected by extreme values
  - **Middle value** for odd; **Mean of the 2 middle values** for even
- **Mode** (most frequent) is not affected by outliers
  - Can have multiple modes (bimodal or multimodal) or none
  - Applicable to non-numerical (qualitative) data

Standard Deviation (σ or SD)
- The dispersion of data values around the mean
- The more tightly clustered the values, the smaller the SD
- If 1 SD = 10, 2 SD = 20, and so on

Frequency Distribution
- How often each distinct value appears in a dataset
- Classes: **Equal** subdivisions based on the spread of values
- Frequency: Number of occurrences in each class/interval
- **Cumulative Frequency** = Sum of Frequencies
- **Relative Frequency (%)** = Frequency / Frequency total
- **Range** = Max - Min
- **Width of each class/interval** = Range / No. of Bars

Histogram
- X-axis: Class, Y-axis: Frequency
- Mean gets drawn to the tail, median stays near middle, slightly towards tail, mode remains at the peak



- The salary histogram exhibits a **right skew** or **positive skew**.
- Observe the presence of a few high values on the right side. We say that the tail is to its right.

Random Variables
- Discrete is **countable** (either finite or infinite). E.g How many coin tosses to get heads
- Continuous is **uncountable** (infinite), E.g Weight, Duration, Height, etc)

Probability Distribution

x	2	3
P(X = x)	0.75	0.25

- E.g P(X = 3) = 0.25,

X = 3 means when X is equal 3, 0.25 probability
- **Sum is always equals 1**
- In a continuous curve, the **total area under the curve equates to 1**

Distribution Shapes
- **Uniform distribution means an equal likelihood** for each outcome
- For discrcete: P(C > 3) ≠ P(C ≥ 3); For continuous: P(C > 3) = P(C ≥ 3)
- **Mean**: Multiply each outcome with respective probability then sum

Expected Value
- Found by finding the **Mean**: E(X) = (probabilty) * (outcome) + ...
- E(X + Y) = E(X) + E(Y)
- Variance quantifies the dispersion of distribution around its mean
- > Difference between actual and expected, > the variance

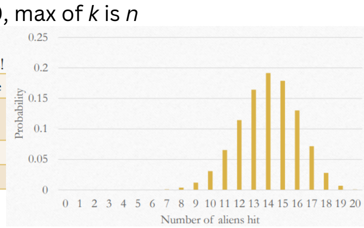
Probability Distribution Family
- Determine the probabilities for all outcomes in a given situation
- Each family has specific conditions, parameters and a function

Uniform Distribution (Discrete)
- Has a **discrete random variable** and **equal probabilities** for all outcomes
- ***k***: Outcome you are keen on
- ***n***: Total number of possible outcomes. Function is $P(X = k) = \frac{1}{n}$

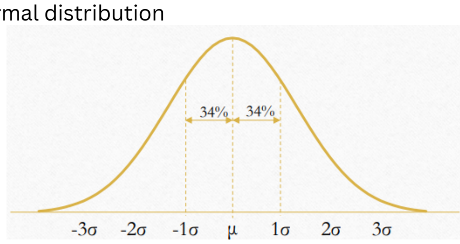
Binomial Distribution (Discrete)
- Distribution of successes in independent binary (**yes/no**) experiments conducted with a **consistent probability** of success
- ***p***: Likelihood of achieving success in a given trial
- **Mean = *n* * *p***
- X-axis: Possible number of successes, Y-axis: Probability of achieving those successes
- Total probabilty = 1, min of *k* is 0, max of *k* is *n*

Anyway, $P(X \geq 12) = 0.85$
- You have an 85% chance of hitting 12 or more aliens!

Parameter Description	Scenario Value
Likelihood of achieving success in any given trial	$p = 0.7$
Number of total trials	$n = 20$
Number of successful outcomes of interest	$k = 12$



Normal Distribution (Continuous)
- Applied to infinite number of potential values. E.g Height, Length
- **Unimodal, symmetrical bellcurve**, but not every bellcurve is a normal distribution
- **Mean** (μ) and **Standard Deviation** (σ)
- **Cannot use "="**. Use cumulative probabilty: P(X > 2.5)
- **Area below the curve equals 1**
- **Half of the curve is 50%** as it is symmetrical
- Central Limit Theorem (CLT)
  - Taking **multiple sample means** from a population will generally form a normal distribution
  - Relevant in nearly all scenarios with repeated selections
  - **Needs a very large sample size**
  - Binomial Distribution can be **well approximated** by a normal distribution
- **Empirical Rule**
  - Only applies to normal distributions
  - Known as the 68-95-99.7 rule
  - **68%** of data will be within 1 SD of the mean
  - **95%** of data will be within 2 SD of the mean
  - **99.7%** of data will be within 3 SD of the mean
  - Can check if a pattern is a normal distribution
    - If 74/85 falls within 1 SD of the data, but it equates to 87.05%, it does not follow the empirical rule, thus it is not a normal distribution



General Forumla for Probability

$$P(E) = \frac{\#\ of\ desired\ outcomes}{\#\ of\ elements\ in\ sample\ space}$$

Addition Rule

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

We roll a 6-sided dice and draw a card from a standard deck. What is the probability of rolling a 5 or drawing an Ace?

Using addition rule:
$P(5 \cup A) = P(5) + P(A) - P(5 \cap A)$
Substituting the multiplication rule for the intersection of the two events:
$P(5 \cup A) = P(5) + P(A) - (P(5) \times P(A))$
$P(5 \cup A) = \frac{1}{6} + \frac{4}{52} - \left(\frac{1}{6} \times \frac{4}{52}\right) = 23.08\%$ (Ans)

Multiplication Rule

$$P(A \cap B) = P(A|B) \times P(B)$$

In a library, 40% of the books are fiction (Event F), and 20% of those fiction books are also mystery novels (Event M). What is the probability that a book is both fiction and a mystery novel?

Using the formula for conditional probability:
$P(M \cap F) = P(M|F) \times P(F)$
$P(M \cap F) = 0.20 \times 0.40 = 0.08 = 8\%$ (Ans)

- For independent events, P(A|B) = P(A)

Conditional Probability

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

Bayes' Theorem

$$P(A|B) = \frac{P(B|A)}{P(B)} \times P(A)$$

In a city, 80% of people prefer electric cars, 95% of people are concerned about the environment. A survey suggests that of those who prefer electric cars, 90% are concerned about the environment. If a person is concerned about the environment, what is the probability they prefer electric cars?

Let E be the event a person prefers electric cars and C be the event they are concerned about the environment.
Given:
$P(E) = 0.80$
$P(C|E) = 0.90$
$P(C) = 0.95$
Using Bayes' theorem:
$P(E|C) = \frac{P(C|E) \times P(E)}{P(C)} = \frac{0.90 \times 0.80}{0.95} = 75.79\%$ (Ans)

Total Probabilty

$$P(A) = P(A|B)P(B) + P(A|B^C)P(B^C)$$

A company sources its raw materials from two suppliers. Supplier A provides 65% of the raw materials, and 3% of its materials are of low quality. Supplier B provides the remaining materials, and 5% of its materials are of low quality. What is the total probability that a raw material sourced by this company is of low quality?

Let L be the event that a material is of low quality, A be the event that a material is from Supplier A, and B be the event that a material is from Supplier B.
Given:
$P(A) = 0.65$
$P(L|A) = 0.03$
$P(L|B) = 0.05$
Using law of total probability:
$P(L) = P(L|A)P(A) + P(L|B)P(B)$
$P(L) = (0.03)(0.65) + (0.05)(0.35) = 3.7\%$ (Ans)

Alternate Total Probabilty

$$P(A|B) = \frac{P(B|A)P(A)}{P(B|A)P(A) + P(B|A^C)P(A^C)}$$

A diagnostic test detects a rare disease that affects 1 in 1000 people. The test has a 1% false positive rate but no false negative rate. If a person tests positive, what is the probability they actually have the disease?

Let D be the event a person has the disease and T be the event they test positive.
Given:
$P(D) = 0.001$
$P(T|D) = 1$ (False negative means that when you are actually positive, you test negative. So no false negative means when you are actually positive, you will definitely test positive.)
$P(T|D') = 0.01$
Using Bayes' theorem:

$P(D|T) = \frac{P(T|D) \times P(D)}{P(T|D) \times P(D) + P(T|D') \times P(D')} = \frac{1 \times 0.001}{1 \times 0.001 + 0.01 \times 0.999} = 9.1\%$ (Ans)

A factory produces light bulbs, and 95% of these bulbs work properly. A quality check is done using a machine that has a 5% error rate (meaning it falsely identifies working bulbs as defective and vice versa). If a bulb is identified as defective by the machine, what is the probability that it is actually defective?

Let D be the event that a bulb is defective, and M be the event that the machine identifies a bulb as defective.
Given:
$P(D) = 0.05$
$P(M|D) = 0.95$
$P(M|D') = 0.05$
Using Bayes' theorem:
$P(D|M) = \frac{P(M|D) \times P(D)}{P(M|D) \times P(D) + P(M|D') \times P(D')} = \frac{0.95 \times 0.05}{0.95 \times 0.05 + 0.05 \times 0.95} = 50\%$ (Ans)

Standard Deviation

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

- ***xi*** represents the i'th value
- **μ** represents the mean
- **N** represents the total count of data points
- **E** represents the sum of all data, stop at N, start at i = 1

Calculate the standard deviation of $\{35, 38, 48, 56\}$.

$$\sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

Find the mean: $\mu = \frac{35+38+48+56}{4} = 44.25$
Sum the squared differences: $(35 - 44.25)^2 + (38 - 44.25)^2 + (48 - 44.25)^2 + (56 - 44.25)^2 = 276.75$
Divide by N: $\frac{276.75}{4} = 69.1875$
Take square root: $\sigma = \sqrt{69.1875} = 8.318$ (Ans)

Frequency Distribution & Histogram

Given the following frequency distribution table, calculate the median value.

Value (class)	Frequency
5	4
6	6
7	5
8	3

There are a total of 18 values (4 + 6 + 5 + 3). The median will lie between the 9th and 10th values. Since the cumulative frequency reaches 10 at the value 6, the median is 6.

A company surveyed 100 people to find out how much they spend on groceries weekly. The highest amount spent was \$200, and the lowest amount was \$50. If they want to create a histogram with 5 bars, how wide should each interval be?

Range = Maximum value - Minimum value = \$200 - \$50 = \$150
Number of bars = 5
Width of each interval = Range / Number of bars = \$150 / 5 = \$30

Probability Distribution

A random variable M represents the number of sixes rolled when a dice is rolled four times. What is the probability that M = 1?

There are 4 ways to get one six: 6XXX, X6XX, XX6X, XXX6 (where X represents not rolling a six).
Therefore, $P(M = 1) = 4 \times \left(\frac{1}{6} \times \frac{5}{6} \times \frac{5}{6} \times \frac{5}{6}\right) = 38.58\%$ (Ans)

4 ways   Roll a 6   Roll a number that is not 6

A spinner is divided into 4 equal parts labelled A, B, C, and D. Let M be the random variable representing the outcome. What is the probability distribution of M?

Each outcome (A, B, C, D) has a probability of 25%.
It would look like:
$P(M = A) = 0.25$
$P(M = B) = 0.25$
$P(M = C) = 0.25$
$P(M = D) = 0.25$

Expected Value & Variance

$$var(X) = E[(X - \mu)^2]$$
$$var(X) = E(X^2) - [E(X)]^2$$
$$var(X) = \frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2$$
$$\sigma = \sqrt{var(X)}$$

Given a discrete random variable X with the following probability distribution:
$P(X = 1) = 0.2$
$P(X = 2) = 0.3$
$P(X = 3) = 0.5$
Calculate the expected value and variance of X.

Solution: Expected value $E(X) = 1(0.2) + 2(0.3) + 3(0.5) = 0.2 + 0.6 + 1.5 = 2.3.$
Variance $Var(X) = E(X^2) - [E(X)]^2$
$E(X^2) = 1^2(0.2) + 2^2(0.3) + 3^2(0.5) = 0.2 + 1.2 + 4.5 = 5.9.$
Variance $Var(X) = 5.9 - 5.29 = 0.61.$
This is 2.3^2

A random variable M represents the number of defective items in a batch of 10. If the probability of an item being defective is 0.05, and items are independent of each other, what is the expected number of defective items in a batch?

Solution: Expected number = $n \times p = 10 \times 0.05 = 0.5.$

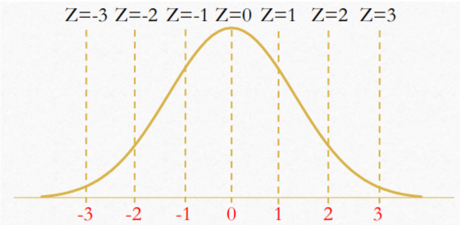
A box contains five chocolates, of which two are dark chocolates. If a chocolate is chosen at random, let N be the random variable representing the type, where dark is 1 and other chocolates are 2. What is the expected value of N?

Solution: Expected value $E(N) = 1(\frac{2}{5}) + 2(\frac{3}{5}) = 1.6.$

A continuous random variable Y has a uniform distribution over the interval [2, 8]. What is the probability that Y takes on a value between 3 and 5?

Solution: For a uniform distribution, the probability is the ratio of the length of the desired interval to the length of the entire interval.
Probability = $\frac{5-3}{8-2} = \frac{2}{6} = \frac{1}{3}.$

Z-Scores and Standard Normal Distributions

- Indicates how many SD a value is from the mean
- Z-score to the left is the graph is negative, right is positive
- Transforms a normal curve into a standard normal distribution, where **μ = 0 and σ = 1**
- Z-table
  - To find **cumulative probabilities**
  - Initial column is the first 2 digits; Header row is the second decimal place
  - For $P(Z < 1.25)$, **refer to the Z-table**
  - For $P(Z > 1.25)$, take **$1 - P(Z < 1.25)$**
  - For $P(0 < Z < 1.25)$, do **$P(Z < 1.25) - P(Z < 0)$**
  - Make use of the Z-score equation to find Z-score first
  - If the question gives %, use Z-table to find the closest value
  - 

$$Z = \frac{X - \mu}{\sigma}$$

X is given in the question

Correlation

- Occurence of one event offers a reasonable forecast of another. E.g light switch and illumination of a bulb
- Positive correlation: Increase in one variable = increase in other variable (**Same direction**)
- Negative correlation: Increase in one variable = decrease in other variable (**Opposite direction**)
- Bi-directional; Sequence of events does not matter
- **Lurking/Confounding variables**: Extra variables that leads to correlations that don't mean anything.

Causation

- Occurs when an event **causes** the other event. E.g Watering a plant increases its height
- Correlation **may not suggest** causation, but causation **suggests** correlation
- Only works in **one-direction**, if X causes Y, Y does not cause X
- Correlation ≠ Causation

Observational Studies

- Ascertain the existence of a correlation, **cannot show causation**
- **No direct influence** on subjects
- Retrospective Study: Examine **past outcomes** of interest
- Prospective Study: Observe **future outcomes** of interest
- **Lurking/Confounding variables are limitations** of these studies

Experiments

- **Actively modifies/influences** conditions during the study
- Eliminates confounding variables and establishes a **cause-and-effect relationship (Causation)**
- Assess whether a certain change (**independent variable**) influences a result (**dependent variable**)
- **Treatment Group:** Receives the intervention
- **Control Group:** Does not receive the intervention
- Only difference between groups is the independent variable
- Placebo effect is a possible confounding variable
  - Ensure both groups encounter it
  - **Blind Experiment:** Participants are unaware which group they are in
  - **Double-Blind Experiment:** Both researchers and participants are unaware which group they are in/studying
- **Blocking:** Grouping subjects based on a confounding variable then randomly assigning them to either experimental groups

Scatter Plots

- Determine if there is a relationship between two variables
- Variables must be **quantitative** (numerical)
- If the points generally form a line, it is a **linear relationship**
- If one value rises and the other also rises, it is a **direct relationship** (upward trend from left to right)
- If the x-values rise and y-values decrease, it is an **inverse relationship** (downward trend from left to right)
- If points are random, it is a **zero-correlation** (no relationship between x and y variables)

Correlation Coefficient

- Represented by ***r***
- Indicates the strength and direction of the association between two variables
- *r* always falls between -1 and +1, the closer *r* is to -1 or +1, the stronger the correlation
- Perfect upward diagonal line is +1, perfect downward diagonal is -1
- Positive *r* shows **direct relationship**; Negative *r* shows **inverse relationship**
- *r* is near 0 if there is **little to no correlation**
  - In a zero-sloped horizontal line, *r* is 0 as x increases, y remains the same. Hence there is no correlation
- Correlation coefficient **< -0.8 or > 0.8** indicates a strong correlation
- Between **0.5 and 0.8** is moderate strong
- Between **0.3 and 0.5** is moderately weak
- Between **0 and 0.3** is weak

Linear Regression

- Examines associations between **quantitative** (numerical) variables, can go further than just correlation and **reveal complex patterns**
- **Regression:** Fitting a curve to the data
- X-axis: independent variable, Y-axis: dependent variable
- Curve provides **predicted** values, actual data are **observed** values
- **Error/Residual** = Observed value - Predicted value
- **Regression Analysis:** Start by selecting a model that aligns with data (Linear, Exponential, Quadratic, Cubic)

Simple Linear Regression

- Draw a straight line through a dataset; Only involves a single independent variable
- **Least Squares Linear Regression:** Align the line as close as possible to all data points
  - **Positive Error:** Observed value is above the line
  - **Negative Error:** Observed value is below the line
  - **Sum up all the squares of the residuals/errors then modify the line to minimize the total**

Statistical Sampling

- **Population:** Every single member (**element**) in a set
- **Sample:** Small subset selected from the entire population
- **Sampling Frame:** A record/collection containing all population members. E.g Yellow phonebook
- Effective samples **accurately reflects** the broader population

Random Sampling

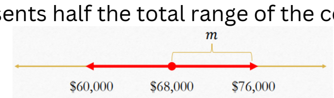
- Start by establishing a frame from the population to get a sample
- Every member of the population must have the **same chance**
- **Simple Random Sampling (SRS):** Randomly generated numbers where ***N*** is all elements and ***n*** is sample size. Generate ***n*** numbers between 1 and ***N***
- **Stratified Random Sampling:** Segment population into strata based on **similar traits**, then conduct SRS. Ensures diverse sections of the population are well represented
- **Cluster Random Sampling:** Segment population into **random clusters**. Use SRS to choose cluster and survey every member within that cluster. This method is cost and time effective
- **Systematic Random Sampling:** Calculate ratio of ***N*** to ***n*** (***N / n***)to get the interval value (***k***). From a random member, select every ***k*** individual. Could be biased but only requires 1 number to do

Non-Random Sampling

- Injected bias, omission of certain elements, fails to accurately reflect entire population
- **Convenience Sampling:** Selecting elements that are **most accessible**. May be speedy/cheap but yields **unreliable outcomes**
- **Quota Sampling:** Segment population into groups, use convenience sampling until required samples are met
- **Snowball Sampling:** Interviewee recommends their friends for future interviews, or when interviewer asks if participants know others to interview. Biased from similar views.

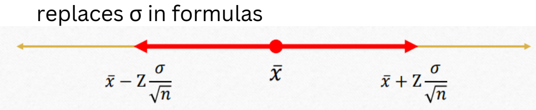
Confidence Intervals

- **Population Parameters (Inferential Stats):** Mean and Proportion
- **μ** for entire population mean, **$\bar{x}$** for sample mean. Not the same
- **Confidence Interval:** Define a range of values where you can confidently expect the true parameter to lie
- **$\bar{x}$** is the **point estimate (PE)**, **margin of error (*m*)** is from PE to end of range. *m* represents half the total range of the confidence interval

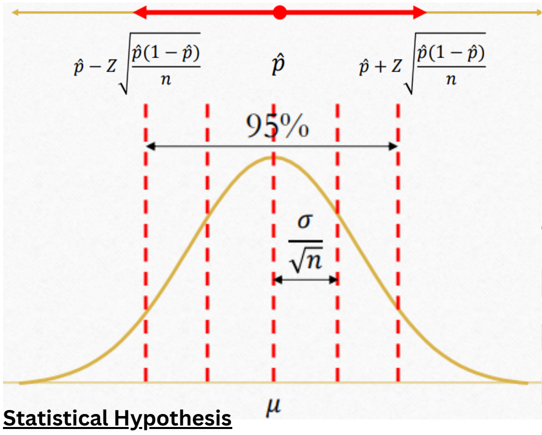


Confidence Intervals (Cont.)

- At 95% confidence level, est. 95% of the intervals would contain the true parameter (**does not mean 95% chance**)
- Charting many sample means against the number of occurrences will result in the **sampling distribution** of the sample mean, which takes the shape of a normal bellcurve (CLT)
- **SD (σ)** of the sampling distribution will be $\frac{\sigma}{\sqrt{n}}$
- Aim to estimate the **proximity of x̄ to μ**
- ***m*** = $Z\frac{\sigma}{\sqrt{n}}$, where Z is the Z-score (critical value). Use empirical rule or Z-table for Z-score
- Sample taken must be **random** and **sample size (*n*) must be at least 30**
- ***s:*** Sample's standard deviation (unsure of μ), replaces σ in formulas



- ***p:*** Population proportion, the % of members in a population that exhibit a specific attribute
- ***X:*** "Success/Has attribute", ***p* = success / population**
- $\hat{p}$ is the sample proportion
- As proportions only have 2 outcomes and are not numeric, "SD" of the sampling distribution for proportions will be $\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$



Statistical Hypothesis

- A testable conjecture regarding a population parameter
- H_0**:** Null hypothesis; No significant change
  - Should be realistic and conservative, a value that is already known
  - Baseline of the study before intervention
- H_a**:** Alternative hypothesis; Deviates from specified value
  - **Cannot be equal to null hypothesis**
- If there is **strong evidence against null**, reject it. Of there is **no strong evidence against null**, do not reject
- Hypothesis testing assists in discerning random variations inherent in data

Setting Criteria

- ***α*:** Significance level; Probability that the mean from the sample leads to incorrectly rejecting the null hypothesis even though its true
- The higher the *α*, the higher probability of wrongly rejecting. If its too low, you may not reject the null hypothesis even though its wrong
- Most frequently used ***α* is 5% or *α* = 0.05**
- **Assumption of Normality:** Sampling distribution is normally distributed and centered around the population parameter
- If alternate hypothesis **≠** 0, rejection region on both sides. *α* is shared (two-tailed test)
- If alternate hypothesis **>**, rejection region is on the right, *α* is whole (one-tailed test)
- If alternate hypothesis **<**, rejection region is on the left, *α* is whole (one-tailed test)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998