1- No of days in week = 7 = n

P(success) = 0.6 = P

P(failure) = 1-0.6 = 0.4 = q

By Bernoulli Distribution formula:-

$P(x=r) = {}^{n}C_r \times p^r \times q^{n-r}$

$P(x=3) = {}^{7}C_3 \times (0.6)^3 \times (0.4)^4$

$= 0.19$

2- $P(R) = 0.3$

$P(D/R)$ = Probab. of stock market will go down after it rains

$= 0.7$

$P(D \cap R)$ = Prob. of both occuring simultaneously

$= P(D/R) \times P(R)$

$= 0.21$

3- $\mu = 0.05$

$\sigma = 0.02$

z-score for 0.03 = $\frac{X-\mu}{\sigma} = \frac{0.03-0.05}{0.02} = -1.00$

z-score for 0.07 = $\frac{0.07-0.05}{0.02} = 1.00$

~~Probability = ...~~

Prob. value for (-1) = 0.15866

Prob value for (1) = 0.84134

⇒ Req. Prob. = $0.84134 - 0.15866$

= 0.68268

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4- In Poisson distribution, the mean represent average no of events happening within a specific interval.

Mean sales per day = 10 units

Expected no. of units sold over 5-day period
= ~~50~~ 5×10
= 50 units.

5- Independent & Identically distributed refers to a specific property of random variables.
→ All the random values in the set share the same probability distribution
→ Outcome of one has no effect on other.

$\boxed{\text{Daily Return}}$ → iid
↓
has variance of 0.0004

⇒ Since daily returns are ~~[illegible]~~ independent, sum of variances over multiple days is simply sum of individual variances.

⇒ Sum of the returns over 10 days is essentially the avg. return multiplied by 10.

Total variance = No. of Days × ~~[illegible]~~ Daily variance
= 0.004

6- variance of time series $= 1$

Autocorrelation at lag k :- $\rho_k = \frac{\gamma_k}{\gamma_0}$

Autocovariance at lag k :- γ_k

$\gamma_0 \rightarrow$ variance of time series

$\rho_k \rightarrow$ autocorrelation at lag k.

$\gamma_k \rightarrow$ autocovariance " "

$\rho_1 = 0.8$

$\rho_2 = 0.6$

$\gamma_0 = 1$

$\gamma_2 = \rho_2 \times \gamma_0 = 0.6$

Autocovariance at lag $2 = 0.6$

7- $\text{Avg}[4,8,6] = \frac{4+8+6}{3} = 6$

$\text{Avg}[8,6,5] = 6.33$

$\text{Avg}[6,5,9] = 6.67$ $\frac{2}{3}$

$\text{Avg}[5,9,7] = \frac{5+9+7}{3} = 7$

$\text{Avg}[9,7,10] = \frac{9+7+10}{3} = 8.67$

3-day moving avg. $\rightarrow$ [6, 6.33, 6.67, 7, 8.67]

8

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Q8-) For ARIMA model:-

$$(1-\phi_1 B)(1-B)\,Y_t = (1+\theta_1 B)\,\varepsilon_t$$

$\phi_1 = 0.7$
$\theta_1 = -0.4$

$$(1-0.7B)(1-B)\,Y_t = (1-0.4B)\,\varepsilon_t$$

After Expanding, apply differencing op.

$$(1-B)\,Y_t = Y_t - Y_{t-1}$$

Now, model eqn:-

$$(1-0.7B)(Y_t - Y_{t-1}) = (1-0.4B)\,\varepsilon_t$$

$$\boxed{Y_t - 1.7Y_{t-1} + 0.7Y_{t-2} = \varepsilon_t - 0.4\,\varepsilon_{t-1}}$$

Interpretation:-

$\boxed{\phi_1 = 0.7}$ → First lag of differenced series is +ve correlated with a cofficient of 0.7. Suggests a strong +ve relationship b/w Y_{t-1} & Y_t after differencing.

$\boxed{\theta_1 = -0.4}$:- First lag of error term (ε_t) has a neg. effect on Y_t with a coeff of -0.4. That is positive error term at time t-1 will result in a decrease in Y_t.

9- Sample mean ($\bar{x}$) = 0.0015

Sample std. dev. (s) = 0.0005

Sample ~~size~~ size (n) = 30

Pop. mean (μ_0) = 0.002

<u>t-statistic</u> :-

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

$$\therefore t \simeq -5.48$$

degrees of freedom = 30 − 1 = 29

Using t-table, critical value = ± 2.045

Since absolute value of calculated t-statistic is greater than t-value, reject null hypothesis

10- Confidence intervals = $\bar{x} \pm \left(\frac{t_{\alpha/2} \times s}{\sqrt{n}} \right)$

$\alpha = 1 - 0.95 = 0.05$

$\alpha/2 = 0.025$

$df = n - 1 = 29$

Conf. Int. = (0.001263; 0.001737)

11- <u>Example of Non-Stationary Time Series</u> :-

Stock price series.

↓

Have trends over time & don't have constant mean / variance.

QS-)

A method to transform a non-stationary time series is differencing.

12- Additive model assumes:-

$$Y_t = T_t + S_t + R_t$$

$Y_t \rightarrow$ Obs. value

$T_t \rightarrow$ Trend component

$S_t \rightarrow$ Seasonal component

$R_t \rightarrow$ Residual component.

Steps to Decompose :-

1- Identify the Trend Component (T_t) by using method such as moving averages / LOESS (Locally estimated Scatterplot smoothing).

2- Extract the Seasonal Component (S_t) :-

~~[illegible]~~ → Deselect seasonality

→ Averaging method.

3- Calculate the Residual Component (R_t)

Subtract both the trend & seasonal components from orig. series to obtain the residual component.

13- MAE (Mean Absolute Error) :-

$$MAE = \frac{1}{n} \sum_{i=1}^{n} |y_i - \hat{y}_i|$$

RMSE (Root mean Squared Error)

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i-\hat{y}_i)^2}$$

Comparing MAE & RMSE :-

→ MAE has linear score, that is all individual diff. are weighted equally.

→ RMSE is quadratic, that is larger errors have a disproportionatly large impact on the score.

Model:

Model A has MAE of 5

Model B has RMSE of 6.

a. ERROR :-

MAE of 5 means avg. absolute error of Model A is ~~too~~ 5 units.

a. RMSE of 6 suggests that the errors are somewhat higher on average for mode B.

∴ Base on MAE of 5 for model A & RMSE of 6 for model B, Model A is considered to perform better due to low avg. error.