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Homework #2

Q.1

1) continuous random variable

2) Probability density function

3) $f(y) = 1$ for y in $[1,2]$, 0 otherwise

$\frac{q-p}{b-a} \rightarrow \frac{2-1}{2-1} \boxed{= 1}$

y can only be between 1 & 2, so probability it is between 1 & 2 is 1.

$q = 1.3$

$\frac{1.3-1}{2-1} = \boxed{.3} \rightarrow$ Prob. of y falling between 1 & 1.3 is .3.

$q = 1.67$

- Because this variable is continuous and random, the probability of y equaling an exact value is 0.

4) $\text{mean} = \frac{a+b}{2} \longrightarrow \text{mean} = \frac{3}{2} = 1.5$

$\text{variance} = \frac{(b-a)^2}{n-1} \longrightarrow \text{variance} = \frac{(2-1)^2}{99} = \frac{1}{99} \approx .0101$

Desired graphite content per batch ($n=100$): 1.8

- Mean = 1.5; Var = .0101 $\rightarrow$ graphite content lowered than desired. The nature of the density function $f(y)$ has a low mean and a low variance.

Q.2 $y_t = \beta_0 + \beta_1 x_t + \beta_2 x_t^2 + \beta_3 z_t + \varepsilon_t$

$\varepsilon_t \overset{iid}{\sim} (0, \sigma^2)$, $t = 1, \dots, T$.

Mean

$E(y_t \mid x_t = x_t^* \text{ \& } z_t = z_t^*) = E(\underbrace{\beta_0 + \beta_1 x_t^* + \beta_2 x_t^{*2} + \beta_3 z_t^*}_{\text{constant term}} + \varepsilon_t)$ $E(\varepsilon_t) = 0$

$$\text{mean}(y_t \mid x_t = x_t^* \;\&\; z_t = z_t^*) = \beta_0 + \beta_1 x_t^* + \beta_2 x_t^{*2} + \beta_3 z_t^*$$

$$\text{var}(y_t \mid x_t = x_t^* \;\&\; z_t = z_t^*) = \text{var}(\beta_0 + \beta_1 x_t^* + \beta_2 x_t^{*2} + \beta_3 z_t^* + \varepsilon_t)$$

$\text{var}(a + x) = \text{var}(x)$ where a is the constant term

Therefore:

$$\text{var}(y_t \mid x_t = x_t^* \;\&\; z_t = z_t^*)\ \text{var}(\varepsilon_t) = \sigma^2$$

- Yes, the conditional mean adapts to the conditioning info.
- No, the conditional variance does not adapt to the conditioning info because the variance is constant σ^2.

Q.3
- t-statistic: larger the t-stat, the greater difference between the 2 groups being compared. The smaller the t-stat, the more similar the means of the 2 groups are.
- prob. value of t-stat: larger t-value, smaller p-value. This provides greater evidence against null hypothesis
- R-Squared: how much variance is explained in model.
- Adj. R-Squared: R-Squared but calculated w/ variables whose addition to the model is significant.
- Standard Error: Avg. distance that is observed w/ data values that fell from the reg. model. Low SE is good for model.
- Sum of Squared Res.: Measures variance in error term. Should be lower than the sum of squares from reg. equation.
- Durbin-Watson Stat.: tests for autocorrelation in the residuals. It will always be between 0-4. 0-2 = pos. corr.; 2-4 = neg. corr. positive correlation is preferred.
- Akaike info criterion: estimator of pred. error. less works better for model.
- Schwarz info criterion: higher = better! SIC<2 is not preferred
- F-stat: if calculated F-value is larger than F stat, reject the null hypothesis. High F-stat is preferred.
- Prob. value of F-stat: probability results could have happened by chance.

Q.4

1) Airborne Analytics

Decision environment - Finance (mutual fund). Trying to select best company to select in bidding war for fighter jets.

Nature of Object - airplanes / fighter jets. Need to select company we believe will win bidding war for jet production.

Forecast type - Density Forecast. Want to try and predict company that will be selected for contract over the other.

Forecast horizon - Short-term forecasts. Need to see who will win contract, not how long it takes to deliver.

Loss function - We want to select the company participating in the bidding war with the smallest loss function. This will help us in identifying the company that is most likely to win the bidding war.

Information set / forecasting approach - For this forecast, we will be using the density forecast method for identifying a prospective winner in the bidding war for production of new fighter jets. We are using a density forecast because we want to analyze the highest probability out of the 2 companies to see who will win the bidding war. This is also a Univariate Model.

2) Forecasting Tax Revenues - OMB

Decision Environment - Office of Management & Budget. Predicting tax rev. in the upcoming fiscal year. Want to lessen government deficit by end of year.

Nature of Object - tax revenues. Would be considered within the time series evaluation as year-over-year tax revenues have data for past 100+ years.

Forecast type - Interval forecast. Want to assess range of predicted tax revenues for the upcoming year.

Forecast Horizon - Short-term forecast. Utilizing h-step ahead forecast to determine tax revs for upcoming year.

Loss function - Want to identify tax revenues with lowest loss function. These data values will most likely be used to identify as the points used in the forecast for the president's budget forecast.

Information set / forecasting approach - This model would be conditional upon a univariate model. This is because we are only predicting tax revenues (y_t) for the upcoming year. There is no need for a very complex model to forecast this value.

3) D & D, create client ad towards teens

Decision Environment - Client ad. Product market is for teenagers. Want to target ad towards that group.

Nature of object - Advertisement. Highly intangible, based on many direct/indirect factors.

Forecast type - Point forecast. Want to identify "X" amount of ad reach to specific teenage group.

Forecast Horizon - long-term forecast. Utilizing h-step path forecast to determine ad impact overtime.

Loss function - Need to analyze ad impact among prospective groupings. See which ones has greatest impact within groups by examing impact of loss function overtime.

Information set/ forecasting approach - For this forecast, we will be using the point forecast method to identifying best ad for the client. The model used would be multivariate due to the variety of different variables impacting the forecast overtime.

5.

1)

- Regression 1
  - Adj R^2 = .001527
  - Std. Error = 4.36
  - DW stat = .374
  - AIC = 788.538
  - SIC = 808.875

- Regression 2
  - Adj. R^2 = .006714
  - Std. Error = 4.35
  - DW Stat = .372
  - AIC = 787.835
  - SIC = 808.172

- Regression 3
  - Adj. R^2 = −.002898
  - Std. Error = 4.37
  - DW Stat = .399
  - AIC = 789.135
  - SIC = 809.472

2)

- In HW 2 R-Script.