**QUIZ ONE**

**1.** According to the Notes and class discussion, which of the following are among the three major steps in the statistical modeling process?

**ANSWERS:** Use the model**,** Validate the model

**NOTES:** The three steps are Propose, Validate, Use.

**2.** According to the Notes and class discussion, who is George Box?

**ANSWER:** A famous statistician. He introduced the Box-Jenkins method of forecasting.

**3.** According to the Notes and class discussion, which are the two primary reasons for studying time series?

**ANSWER:** Explain the present, Forecast the future

**4.** (T/F)According to the Notes and class discussion, expecting to get help in forecasting by finding traces of the future in the past is a science-fiction fantasy.

**ANSWER:** False

**NOTES:** Actually, it is the opposite: If there is no trace of the future in the past in some form, then there is no way to forecast the future scientifically.

**5.** (T/F) According to the Notes and class discussion, if a time series model is appropriate for explaining the present, then it will also be appropriate for forecasting the future.

**ANSWER:** False

**NOTES:** Sometimes - so not always. A model that gives a good explanation of the present using contemporaneous predictors would need to have values for those predictors in the time period being forecast in order to be appropriate. All future predictor values must be known at the time that the forecast is made.

**QUIZ TWO**

Suppose that daily sales Y1, Y2, …, Y100 were observed for 100 days. Suppose that they passed all of the tests for being a Random Sample, and:

-The mean of Y1, …, Y100 is 100;

-The standard deviation of Y1, …, Y100 is 30;

-Y1 = 96;

-Y100 = 104;

**1.** The mean sales for all days can be expected to differ from mean sales of Y1, …, Y100 by about ± \_\_\_?

**ANSWER:** 3

**NOTES:** The sampling dist. of the mean of 100 RS data is roughly normal (C.L.T.) with mean =mean of parent distribution = 100, and stdev = stdev of parent dist / sqrt(n) = 30 /(100/10) = 3.

**2**. The best forecast of sales on day 101 is \_\_\_?

**ANSWER**: 100 (with margin: 0.5)

**NOTES**: The best forecast of the next value of a RS is the mean of the past.

**3.** The expected difference between actual sales on day 101 and the best forecast of sales on day 101 is about ± \_\_\_?

**ANSWER:** 30

**NOTES:** The expected deviation from the RS forecast is the standard deviation of the past. (Somewhat better estimate is S\*sqrt(1 + 1/n) = 30.1496.)

**4.** The probability that the mean sales for all days will differ from mean sales of Y1, ..., Y100 by no more than ± 30 is approximately \_\_\_?

**ANSWER:** 1 or 100

**NOTES:** The Central Limit Theorem applies to probabilities about the mean (appropriate here) provided the sample size is sufficiently large (n=100 qualifies). The question asks for the probability within ± 30, which is 10 standard errors ( 1 st err = 30 / sqrt(100) = 3, so ± 30 is 30 / 3 = 10 st errors of difference). This is nearly the entire range of a normal distribution, so has nearly 1 probability.

**5.** The probability that the actual sales for day 101 will differ from the best forecast of sales on day 101 by no more than ± 30 is approximately \_\_\_?

**ANSWER:** unknown

**NOTES:** This probability is not known. It is incorrect to assume that sales are normally distributed. Being normally distributed is NOT part of the definition of RS. The sample size is large, but the Central Limit Theorem gives approx. normality for the sampling distribution of x-bar, not for the distribution of the parent population.

**QUIZ THREE**

**1.** (T/F)The time plot of a Random Walk will probably look like a horizontal band of data points.

**ANSWER:** False

**NOTES:** The data path of a Random Sample should look like a horizontal band of points. The data path of a Random Walk meanders around.

**2.** (T/F)The best forecast of the next value of a Random Walk is the mean change of the data from one time period to the next.

**ANSWER:** False

**NOTES:** The best forecast is the last value + mean change of the data.

**3.** The (lag 1) autocorrelation of a Random Walk should be

**ANSWER:** NONE OF THE ABOVE

**NOTES:** The (lag 1) autocorrelation of a Random Walk should be close to 1. The reason is that for a RW, the valid autoregression Yt = a + B\*Yt-1 has slope B close to 1 and the slope of a simple autoregression is roughly the autocorrelation of Yt.

**4.** (T/F) A time series cannot be both a Random Sample and a Random Walk.

**ANSWER:** TRUE

**NOTES:** One way to see this: If Yt is both a RS and a RW, then when Yt is regressed upon Yt-1, the slope of the regression would be both 0 (for RS) and 1 (for RW). But the slope cannot be both 0 and 1.

**5.** The standard deviation of the autocorrelation of a Random Sample of 100 consecutive time series data is approximately \_\_\_?

**ANSWER:** 0.1

**NOTES:** Stdev(autocorr) is approx. 1/sqrt(n data pairs), which is approx. 1/sqrt(100) = 0.10.

**QUIZ FOUR**

**1.** Under which of the following conditions would the (RS) model be a valid model for a time series Yt?

**ANSWER:** The regression model Yt = α + βYt-1 + εt is a valid regression model and β = 0.

**NOTES:** The definition of a (RS) does not refer to its changes. In fact, the changes in a RS could not be a (RS), or else the original time series would be a (RW) by definition. In further fact, the changes in a (RS) are negatively correlated. The intuition: Suppose the current change in a (RS) is positive; then the current value is more likely than not to be high (above the mean); so the next move is more likely than not to be down (toward the mean); i.e., the next change is likely to be negative. That is, we should expect the changes in a (RS) to alternate in sign. This is negative autocorrelation. (In still further fact, the changes in a (RS) have an autocorrelation of -0.50.) So the changes in a (RS) cannot be a (RW) either.

In an alt. approach, if a valid autoregression has a slope of 0, then the original time series is a (RS).

**2.** The value of loge(0.95) is approximately \_\_\_?

**ANSWER:** -0.05

**NOTES:** From the Taylor series approx. loge(1 + x) ≅ x, we have loge(0.95) = loge(1 + (-0.05)) ≅ -0.05.

**3.** Under which of the following conditions would the random walk (RW) model be a valid model for a time series Yt? **Answered**

**ANSWERS:** -The period-to-period changes, Yt - Yt-1, are a random sample (RS).

-The regression model Yt = α + βYt-1 + εt is a valid regression model and β = 1.

**NOTES:** The definition of a (RW) is that the changes are a (RS). An equivalent formulation is that the slope in the valid simple autoregression is 1.

**4.** Under which of the following conditions would the geometric random walk (GRW) model usually be preferred to the random walk (RW) model for a time series Yt?

**ANSWERS:** -When the variability of Yt is proportional to the value of Yt.

-When Yt is increasing substantially over the time period under study.

-When Yt is decreasing substantially over the time period under study.

**NOTES:** By definition, the proportional changes (returns) of a (GRW) are stable. This is more likely than stable changes to be the case if the values are changing substantially over time, whether increasing or decreasing. When the levels of the time series are fairly constant, there is not much to choose between (RW) and (GRW).

**5.** Under which of the following conditions would the geometric random walk (GRW) model be a valid model for a time series Yt that has all positive values?

**ANSWERS: -**log (Yt) is a random walk (RW).

**-**The period-to-period changes, log (Yt) - log (Yt-1), are a random sample (RS).

**NOTES:** Yt is a (GRW) iff log (Yt) is a (RW) iff the changes in log (Yt) are a (RS).

**QUIZ FIVE**

**1.** (T/F) In determining whether the time series model Yt = a + b Yt-1 + et is a valid regression, the "L" specification can be tested quantitatively by Ramsey's RESET procedure, which is available as an option in PROC REG in SAS.

**ANSWER:** False

**NOTES:** Ramsey's RESET is an option in PROC AUTOREG but not in PROC REG

**2.** (T/F) In determing whether the time series model Yt = a + bYt-1 + et is a valid regression, the "H" specification can be tested quantitatively by White's SPEC procedure, which is available as an option in PROC REG in SAS.

**ANSWER:** True

**NOTES:** White's SPEC procedure is available in PROC REG but not in PROC AUTOREG.

**3.** Suppose that the time series model Yt = a + bYt-1 + et is a valid regression.  
Select all of the following that is/are true:

**ANSWERS: -**b is approximately equal to the (lag 1) autocorrelation of Yt

-b is approximately equal to the correlation between Yt and Yt-1

-the autocorrelation of et is approximately 0

**NOTES:** b = corr(Yt ,Yt-1) stdev(Yt) / stdev(Yt-1) approx. corr(Yt,Yt-1), which is the (lag 1) autocorr of Yt. The intercept a could be anything - e.g., take b=1, then a is the mean change in Y from one time period to the next. The error terms et should be independent, so should have no autocorrelation.

**4.** (T/F) An autoregression is a time series regression in which one or more predictor variables are lags of the response variable.

**ANSWER:** True

**5.** (T/F) If the time series model Yt = a + b Yt-1 + et is a valid regression, then the time series et is a special case of an autoregression.

**ANSWER:** True

**NOTES:** In a valid time series regression, the error term is a RS, which is a special case of an autoregression.

**QUIZ SIX**

**1.** (T/F) The following SAS code can be used to implement White's test of homoscedasticity:

*proc autoreg data = ozone;  
    model ozone = lagozone / spec;  
run;*

**ANSWER:** False

**NOTES:** The code would be correct if it read "proc reg" instead of "proc autoreg.

**2.** Which of the following is/are tests of normality that is/are implemented in SAS?

**ANSWERS:** B. Shapiro-Wilk test

D. Anderson-Darling test

**NOTES:** NORMALITY=SWAD. There are four tests implemented in PROC UNIVARIATE: Kolmogorov-Smirnov, Shapiro-Wilk, Cramer-von Mises, Anderson-Darling.

**3.** (T/F) When the NLAGS=2 option is used in proc autoreg, SAS will run two regressions: The first runs the MODEL statement as though it were an ordinary least squares with independent errors; the second runs the MODEL statement as though the errors are autoregressive of order 2.

**ANSWER:** TRUE

**NOTES:** Class discussion of PROC AUTOREG in SAS OnDemand.

**4.** Which of the following statements is/are true of the Durbin-Watson statistic (DW)?

**ANSWERS:** -DW close to 4 indicates likely rej of Ho: the residuals are positively autocorrelated

-DW can be calculated in PROC REG in SAS.

-DW close to 2 indicates likely failure to rej Ho: the residuals are not positively

autocorrelated and Ho: the residuals are not negatively autocorrelated.

**NOTES:** The range of DW is approximately 0 to 4, with 0 indicating + autocorrelation of the residuals, 4 indicating - autocorrelation, and 2 indicating 0 autocorrelation.

**5.** (T/F) In general, a time series model that includes lags of the Y variable as predictors and has independent errors is equivalent to a time series model that does not include lags of the Y variable as predictors but does include autoregressive errors.

**ANSWER:** True

**NOTES:** See "An Alternative View of Autoregression" (p.6) in Autoregression.pdf.

**QUIZ SEVEN**

**1.** Which of the following variables would be *deterministic predictors* in a regression model to forecast the dollar value of monthly revenue for Facebook?

**ANSWER:** The month number, starting with January of 2015 as 1.

**NOTES:** The value of a deterministic predictor is known now for all future time. That is true of the month number and of M1, but not of any of the lags, which are known only one month ahead, nor of the (concurrent) value of labor costs.

**2.** (T/F) Plotting the time series data values in chronological order is highly recommended when starting to build a model to forecast or explain a time series.

**ANSWER:** True

**NOTES:** Plotting the data can help identify predictor variables and suggest the form of the model, and might identify threats.

**3.** (T/F) It is largely approximately true that a time series model with the lag of Y as an explicit predictor and having errors that are a valid Random Sample is equivalent to the corresponding model that lacks the lag of Y as an explicit predictor but has errors that are a valid autoregression of order.

**ANSWER:** True

**4.** Which of the following statements is/are true about the SAS code:

*proc autoreg data=Houston;  
 model Ozone =  / nlags = 1 dwprob;  
run;*

**ANSWERS:** -Output is produced for the model Ozone = constant + et, where et is a (RS)

-The residuals are tested for positive and negative autocorrelation.

-Output is produced for Ozone(t) = a + u(t), where u(t) is autoreg order 1.

**NOTES:** nlags = 1 triggers two regressions, both with the explicit parts Y(t) = const + u(t), but one in which u(t) is a (RS) and the other in which u(t) is an AR1 process. dwprob triggers testing for positive and negative autocorrelation with the Durbin-Watson statistic. The model Ozone(t) = Ozone(t-1) is not explicitly estimated.

**5.** Suppose that you are forecasting monthly sales (Yt) on the basis of budgeted monthly costs (Xt). You have a model Yt = 5 + 0.5\*Xt + ut that you have validated as satisfying L,H,N but the errors ut are autoregressive order 1 with autocorrelation coefficient = 0.7. For this month, you budgeted Xt = 20 and calculated 5 + 0.5\*20 = 15, but actual sales this month are 25. Suppose that your budget for costs next month is 30. According to your model, what is the numerical value of the best forecast of sales for next month?

**ANSWER:** 27

**NOTES:** The forecast is:

---Y(t+1) = 5 + 0.5\*X(t+1) + u(t+1) = 5 + 0.5\*30 + u(t+1) = 20 + u(t+1) = 20 + 0.7\*ut + e(t+1)

---The error ut for this month = 25 - 15 = 10.

---e(t+1) is a 0-mean (RS) in the AR1 model, so is forecast to have 0 value.

---So the forecast = 20 + 0.7\*10 + 0 = 27.

**QUIZ EIGHT**

**1.** A multiple regression that has p = 15 predictors and n = 40 observations is most likely to experience which of the following?

**ANSWER:** overfitting

**NOTES:** When the n/p ratio < 5, overfitting is likely.

**2.** Which of the following, if any, was/were identified in class and in the notes as among the three most desirable model-building criteria?

**ANSWERS:** Validity, Explanatory power

**NOTES:** The three are (1) explanatory power, (2) parsimony, (3) validity.

**3.** Not counting the set that has no predictors, how many different sets of predictors can be made from {X1, X2, X3, X4, X5, X6, X7}?

**ANSWER:** 127

**NOTES:** There are 2^7 - 1 = 127.

**4.** Which of the following options could be used in a stepwise regression in SAS to limit the addition of predictors to those that would have p-values less than 0.05 if added to the model?

**ANSWER:** SLENTRY = 0.05

**5.** Which of the following features, if any, were identified as being very commonly found in time series?

**ANSWERS:** Seasonality & Trends

**QUIZ NINE**

**1.** (T/F) It is often unwise to rely upon R-square to assess how well a model fits the data.

**ANSWER:** True

**2.** (T/F) Suppose that  log Y(t) = 3 + 0.05\*t  + e(t)  is a valid regression model, with R-square = 0.90 and RMSE = 0.03 and where log is the logarithm to the base e.  Then the approximate average error that the model makes in estimating Y(t) is +/- 0.03.

**ANSWER:** False

**NOTES**: +/- 0.03 is the approx average error in estimating log Y(t), which converts into approx average error of +/- 3% in estimating Y(t).

**3.** (T/F) When modeling a time series Y(t) that is suspected of growing or declining at a compounded rate, consideration should generally be given to modeling the logarithm of Y(t) instead of Y(t) itself.

**ANSWER:** True

**NOTES:** The logarithm converts *compounded* growth or decline into *linear* growth or decline, making the modeling easier.

**4.** (T/F) Suppose that  log Y(t) = 3 + 0.05\*t  + e(t)  is a valid regression model, with R-square = 0.90 and RMSE = 0.03 and where log is the logarithm to the base e. Then an increase of 1 in t is expected to increase Y(t) by approximately 5%.

**ANSWER:** True

**NOTES:** log Y(t) = 3 + 0.05\*t is expected to go to log Y(t+1) = 3 + 0.05\*(t + 1), so Y(t) is expected to go to Y(t+1) = exp(3 + 0.05\*t + 0.05)  = exp(3 + 0.05\*t) \* exp(0.05) approx Y(t) \* (1 + 0.05), which is an increase of 5%.

**5. (**T/F) Suppose that  log Y(t) = 3 + 0.05\*t  + e(t)  satisfies L,H,N but there is statistically significant (lag 1) autocorrelation in the residuals. Then consideration should generally be given to adding (lag 1) of  Y(t) as a predictor in the model.

**ANSWER:** False

**NOTES:** Autocorrelation in the residuals is generally equivalent to autoregression in the response variable. So consideration should be given to adding (lag 1) of log Y(t) as another predictor, rather than (lag 1) of Y(t).

**QUIZ TEN**

**1.** (T/F) Suppose that differencing a time series Yt at lag 1, followed by differencing the result at lag 12, produces a time series Wt.  
Suppose that differencing the same time series Yt at lag 12, followed by differencing the result at lag 1, produces a time series Zt.  
Then Wt = Zt.

**ANSWER:** True

**NOTES:** The order of differencing does not matter. Class discussion of Austin Home Sales 3 - differencing.xls.

**2.** Which of the following are major phases in the ARIMA strategy for modeling?

**ANSWERS:** Forecasting, Identification, Estimation and diagnostics

**3.** Differencing of time series is ...

**ANSWERS:** -a primary method for removing trends in ARIMA.

-a primary method for removing seasonality in ARIMA.

-part of a way to determine if a ts is a (RW)

**NOTES:** See p.2 of Time Series Analytics Notes - ARIMA remarks.pdf and in-class discussion for correctness of (A) and (B). For (D), refer to the definition of RW.

**4.** (T/F) If you process a time series by differencing it within PROC ARIMA in SAS, then any forecasts made by ARIMA will be forecasts of the differenced time series - so to get forecasts of the original time series, you will have to manually convert the difference forecasts by reversing the differencing process.

**ANSWER:** False

**5.** Suppose that e(t) is a Random Sample time series. Suppose that a time series Z(t) satisfies Z(t) = a + e(t) + b\*e(t-1), where a and b are non-zero parameter constants. Which of the following statements is/are true?

**ANSWER:** Z(t) is a first-order moving average.

**QUIZ ELEVEN**

**1.** Suppose that model A results from the SAS code:

*proc arima data=Austin\_homes;  
    identify var=sales(1);  
    estimate p=1;*

*run;*

and model B results from:

*proc arima data=Austin\_homes;  
    identify var=sales(1);  
   estimate q=1;*

*run;*

Then, absent other information, which of the following conclusions is most nearly correct?

**ANSWER:** Model A fits the data better than model B in terms of explanatory power and parsimony if the AIC of A is less than the AIC of B.

**NOTES:** The AIC is a measure of fit that tries to balance explan. power AND parsimony. Lower scores are better.

**2.** Suppose that Y(t) is a time series with the following mean function:

E(Y(1)) = 2, E(Y(2)) = 5, E(Y(3)) = 10, E(Y(4)) = 17, E(Y(5)) = 26, E(Y(6)) = 37, E(Y(7)) = 50, E(Y(8)) = 65, ...

Which of the following procedures will most effectively make the mean function stationary?

**ANSWER:** Difference chron. adjacent values and then difference the differences that are chronologically adjacent.

**NOTES:** Diff. of adjacent means yields 3 5 7 9 11 13 15 ... Diff. of adjacent differences yields 2 2 2 2 2 2 ...

**3.** In SAS, what does the following code do?

*proc arima data=Austin\_homes;  
    identify var=sales(1);  
   estimate p=1;  
   forecast lead=4;*

*run;*

**ANSWERS:** -Fits an autoregressive order 1 model to the period-to-period differences in the variable SALES.

-Forecasts SALES for each of the next 4 periods.

**NOTES:** The working series is SALES(t) - SALES(t-1) [from *identify var=sales(1);*], to which an autoregression of order 1 (p=1) is fit: So SALES(t) - SALES(t-1) is regressed on its lag (SALES(t-1) - SALES(t-2)) - equivalent to including the lag of the residuals in a regression with SALES(t) - SALES(t-1) as the Y variable. The statement *forecast lead=4;*  says to forecast the working series 4 time periods into the future, but PROC ARIMA converts that back into forecasts of SALES itself.

**4.** Which of the following time series are always stationary?

**ANSWERS: -**A Random Sample

-The residuals in a valid time series regression.

**NOTES:** See Examples, p.2 of Notes on stationarity. Normal with mean t violates constant mean requirement.

**5.** If Y(1), Y(2), ... is a stationary time series, then ...

**ANSWERS: -**The mean of Y(t) is the same for all t.

-The variance of Y(t) is the same for all t.

-The correlation between Y(t) and Y(t-1) is the same for all t > 1.

**NOTES:** The distribution need not be the same, but the mean, variance, and autocorrelation are the same.

**QUIZ TWELVE**

**1.** Suppose that Y(t) is a Random Walk. Then which of the following statements is/are true?

**ANSWERS: -**Y(t) is integrated at order 1.

-Y(t) is integrated at order 2.

**NOTES:** To be integrated at order k means that the difference at order k is stationary. To be integrated at order 0 means that the time series itself is stationary. RW is not stationary, so the 1st and 4th answers (which mean the same thing) are wrong. Since the difference of a RW is a RS (which is stationary), Y(t) is integrated at order 1. Since the difference of a RS is stationary, Y(t) is integrated at order 2.

**2.** In the time series of monthly sales for the Northern Napa Valley Winery case, which of the following common time series features is/are present?

**ANSWERS:** Trend, Seasonality, Increasing Variability

**NOTES:** A time plot shows the first three features. There are no missing data.

**3.** Suppose that the actual value of monthly sales for April of 2022 is $5,000 but the estimated trend of sales for April of 2022 is $6,000 and the seasonal effect for April is $3,000.  If there are no other component features than trend and seasonal, what value of sales was predicted for April of 2022?

**ANSWER**: 9000

**NOTES:** The forecast = trend + seasonal = 6000 + 3000 = 9000.

**4.** Suppose that the actual value of monthly sales for April of 2022 is $5,000 but the estimated trend of sales for April of 2022 is $6,000 and the seasonal effect for April is $3,000.  Then what is the value of detrended sales for April of 2022?

**ANSWER:** -1,000 (with margin: 1)

**NOTES:** Detrend = Actual - Trend = 5000 - 6000 = -1000.

**5.** Suppose that X(t), Y(t), Z(t) are time series such that Y(t) = X(t) + Z(t) and Z(t) is stationary. Then which of the following is true?

**ANSWER:** Y(t) and X(t) are co-integrated.

**NOTES:** Two time series are co-integrated if there is a linear combination of them that is stationary (at some order). Since 1\*Y(t) - 1\*X(t) = Z(t) is stationary, then Y(t) and X(t) are co-integrated. For no other pair of time series is there necessarily a combination that is stationary. If we know only that Z(t) is stationary, then X(t) could be a RW (which is nonstationary), in which case Y(t) is also nonstationary.

**QUIZ THIRTEEN**

**1.** Which is the best description of what the following SAS code accomplishes?

*proc arima data=test;  
    identify var=sales(1);  
   estimate p=1;*

*run;*

**ANSWER:** Fits an autoregressive model of order 1 to the differences between successive values of the variable sales.

**NOTES:** var=sales(1)  indicates that Y = sales - lag(sales) is the response variable. The p=1 part indicates that the model is autoregressive (p) [moving average would use the "q" parameter] of order 1.

**2.** Suppose that Model A and Model B are both multiple linear regressions, take their Y and X variables from the same dataset, and have the same response variable Y. Model A has two predictor variables X1 and X2. Model B also has the predictor variables X1 and X2 but also includes a third predictor variable X3. Is it possible that Model A has a better AIC than model B?

**ANSWERS:**

**-**Yes, model A could be better (or worse) if X3 has some missing values.

-Yes, it is possible even if X3 has no missing values, provided X3 adds very little explanatory power to that of Model A.

-No, it is not possible, provided X3 has no missing values and adds sufficiently much explanatory power to that of Model A.

**NOTES:** AIC (like R-square) is affected if the data that are actually used in the calculations change between models, and can go up or down depending upon which data are missing. AIC (unlike R-square, but like adjusted R-square) has a penalty that increases with model complexity. AIC will improve if the added explanatory power exceeds the penalty, but will deteriorate if the added explanatory power is insufficient to overcome the penalty.

**3.** (T/F) Creating an indicator variable X(t) having the value 1 in a given time period and the value 0 in all other time periods and using X(t) as a predictor variable is a way to model an unknown cause that distorts the model in the given time period.

**ANSWER:** True

**NOTES:** Class discussion of the Northern Napa Valley Winery case, e.g., creation of the indicator MONTH8.

**4.** Suppose a valid regression model in which the response variable is log(Sales), and log is the logarithm to the base e = 2.71... . Suppose this model has RMSE =0.03. Then which of the following statements is the best?

**ANSWER:** Sales can be estimated to within an average accuracy of approximately +/- 3%.l

**NOTES:** The average accuracy in terms of logs is +/-0.03, which is equivalent to roughly +/- 3% in terms of sales.

**5.** Suppose the Model A has AIC = -200, Model B has AIC = -150, Model C has AIC = 250. All three models have the same Y variable and take their Y and X variables from the same complete dataset. All other things being the same, which model would be preferred?

**ANSWER**: A, because A has the smallest AIC.

**NOTES:** Other things being the same, the model with best (smallest) AIC would be preferred.