TEST #1 STA 4853 March 2, 2022

Name:

Please read the following directions. DO NOT TURN THE PAGE UNTIL INSTRUCTED TO DO SO

Directions

- This exam is **closed book** and **closed notes**.
- There are **35** multiple choice questions.
- Circle the **single best** answer for each multiple choice question. Your choice should be made clearly.
- Always circle the correct response. (Sometimes the question has an empty blank or a box, but this is **NOT** where the answer goes.)
- There is no penalty for guessing.
- The exam has **11** pages.
- Each question is worth equal credit (except Problem 13, which gets a double weight so that the highest possible raw score is 36).

Problem 1. Suppose we fit a regression model to data. If the regression assumptions are valid, the plot of the residuals versus the fitted values (also called predicted values) will _____.

- a) often be used to detect cases with unusual covariate values
- **b**) be useful whenever the data are time ordered
- \mathbf{c})* be centered about zero with no bend
- d) follow roughly a straight line with positive slope
- e) be useful in detecting serial correlation
- \mathbf{f}) have a two standard error band with increasing width

Problem 2. If $\{z_t\}$ is an MA(4) process then z_{t-2} depends on the random shocks _____

a) $\{a_{t-2}, a_{t-3}, a_{t-4}\}$ b) $\{a_{t+4}, a_{t+3}, \dots, a_{t-2}\}$ c) $\{a_{t+4}, a_{t+3}, a_{t+2}\}$ d) $\{a_{t+2}, a_{t+1}, \dots, a_{t-4}\}$ e) $\star \{a_{t-2}, a_{t-3}, \dots, a_{t-6}\}$ f) $\{a_t, a_{t-1}, \dots, a_{t-6}\}$

Problem 3. Suppose the SAS output for some parameter gives an estimate of 0.23978, a standard error of 0.09915, a *t*-value of 2.42, and a *p*-value of 0.0156. Which of the following is true?

- a) When the true value of the parameter is zero, the probability of getting a value of |t| equal to 2.42 is 0.0156 or larger.
- b) When the true value of the parameter is 0.23978, the probability of getting a value of |t| which is 2.42 or larger is approximately 0.0156.
- c) When the true value of the parameter is 0.23978, the probability of getting a value of |t| equal to 2.42 is 0.0156 or larger.
- d) When the true value of the parameter is zero, the probability of getting an estimate greater than 0.23978 is approximately 0.0156.
- e) When the true value of the parameter is zero, the probability of getting an estimate equal to 0.23978 is 0.0156 or larger.
- f) \star When the true value of the parameter is zero, the probability of getting a value of |t| which is 2.42 or larger is approximately 0.0156.

Problem 4. If Y and Z are independent random variables, then E(YZ) =_____.

a) $EY + EZ$	\mathbf{b}) 0	c) $\operatorname{Var}(Y) + \operatorname{Var}(Z)$	d) $\operatorname{Cov}(Y, Z)$
$\mathbf{e}) \ E\big(\widetilde{Y}\widetilde{Z}\big)$	$\mathbf{f}) \ E(a_s a_t)$	$\mathbf{g}) \ E(z_s a_t)$	\mathbf{h})* $(EY)(EZ)$

Problem 5. The ACF plot produced by PROC ARIMA has a band marked at two standard errors. For a ______ process, after lag 3 we expect all (or nearly all) of the values r_k to lie within this band, most of them being well inside the band.

a) ARMA(1,3) b) ARMA(3,1) c) ARMA(3,3) d) \star MA(3) e) AR(3)

Problem 6. An ARMA(1,2) model has been fitted to a time series of length 100 using METHOD=ML. In the SAS output, immediately after the table labeled **Maximum Likelihood Estimation** there is another table which is given below. In this table, the value 2.819585 which is labeled **Std Error Estimate** is ______

a)
$$\hat{\sigma}_z$$
b) $\star \hat{\sigma}_a$ c) $\hat{\sigma}_a^2$ d) $\hat{\sigma}_z^2$ e) $\operatorname{SE}(\hat{\theta}_1)$ f) $\operatorname{SE}(\hat{\theta}_2)$ g) $\operatorname{SE}(\hat{\phi}_1)$ h) $\operatorname{SE}(\hat{C})$

Constant Estimate	4.037071
Variance Estimate	7.950057
Std Error Estimate	2.819585
AIC	495.7337
SBC	506.1544
Number of Residuals	100

Problem 7. In a regression of a response variable Y on two covariates X_1 , X_2 with a sample of size n, the estimates $\hat{\beta}_0$, $\hat{\beta}_1$, $\hat{\beta}_2$ are the values of β_0 , β_1 , β_2 which minimize _____.

$$\mathbf{a} \sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_{1,i} - \beta_2 X_{2,i})$$

$$\mathbf{b} \sum_{i=1}^{n} (Y_i + \beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i})$$

$$\mathbf{b} \sum_{i=1}^{n} (Y_i + \beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i})^2$$

$$\mathbf{d} \times \sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_{1,i} - \beta_2 X_{2,i})^2$$

$$\mathbf{f} \sum_{i=1}^{n} |Y_i - \beta_0 - \beta_1 X_{1,i} - \beta_2 X_{2,i}|$$

$$\mathbf{f} \sum_{i=1}^{n} |Y_i + \beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i}|$$

Problem 8. In PROC ARIMA the statement

ESTIMATE P=(1,4) Q=(2,3);

will fit which of the following models?

Problem 9. For an AR(p) model, the CLS method estimates parameters by those values

a) which minimize
$$\sum_{t=1}^{n} (z_t + C + \phi_1 z_{t-1} + \dots + \phi_p z_{t-p})$$
 where $z_t = 0$ for $t < 1$.

- **b**) which maximize the likelihood of the observed data z_1, \ldots, z_n assuming the shocks a_t are independent $N(0, \sigma_a^2)$.
- c) which minimize the likelihood of the observed data z_1, \ldots, z_n assuming the shocks a_t are independent $N(0, \sigma_a^2)$.
- d) which minimize the likelihood of the observed data z_1, \ldots, z_n without assuming the shocks a_t are normally distributed.

e) which minimize
$$\sum_{t=1}^{n} |z_t + C + \phi_1 z_{t-1} + \dots + \phi_p z_{t-p}|$$
 where $z_t = 0$ for $t < 1$
f)* which minimize $\sum_{t=1}^{n} (\tilde{z}_t - \phi_1 \tilde{z}_{t-1} - \dots - \phi_p \tilde{z}_{t-p})^2$ where $\tilde{z}_t = 0$ for $t < 1$.

Problem 10. Suppose you have a very long time series z_1, z_2, \ldots, z_n which is generated from an AR(2) process, and you create the lagged variables $z_{t-1}, z_{t-2}, z_{t-3}$, and z_{t-4} (that is, you create z lagged by 1, z lagged by 2, etc. which are more briefly written as zlag1, zlag2, zlag3, zlag4). If you fit the regression of z_t on $z_{t-1}, z_{t-2}, z_{t-3}, z_{t-4}$ (i.e., the regression of z on the variables zlag1, zlag2, zlag3, zlag4), then the regression coefficients for z_{t-3} and z_{t-4} will ______.

e) be positive and zero, respectively

 \mathbf{b}) both be negative

- \mathbf{c}) be positive and negative, respectively
- d) be negative and positive, respectivelyf)★ both be very close to zero

Problem 11. An AR(1) process is _____.

- **a**) stationary if $\phi_1 < 1$, and non-stationary if $\phi_1 \ge 1$
- **b**) stationary if $\phi_1 \leq 1$, and non-stationary if $\phi_1 > 1$
- c) stationary if $\phi_1 > 1$, and non-stationary if $\phi_1 \leq 1$
- **d**) stationary if $\phi_1 \ge 1$, and non-stationary if $\phi_1 < 1$
- **e**) \star stationary if $|\phi_1| < 1$, and non-stationary if $|\phi_1| \ge 1$
 - **f**) stationary if $|\phi_1| \leq 1$, and non-stationary if $|\phi_1| > 1$
- **g**) stationary if $|\phi_1| > 1$, and non-stationary if $|\phi_1| \le 1$
- **h**) stationary if $|\phi_1| \ge 1$, and non-stationary if $|\phi_1| < 1$

Problem 12. Let L be the likelihood value, k be the number of estimated parameters, and n be the number of residuals. The AIC is equal to ______.

a)
$$-2\ln(L) - 2k$$
 b) $\star -2\ln(L) + 2k$ c) $+2\ln(L) - 2k$ d) $+2\ln(L) + 2k$
e) $-2\ln(L) - k\ln(n)$ f) $-2\ln(L) + k\ln(n)$ g) $+2\ln(L) - k\ln(n)$ h) $+2\ln(L) + k\ln(n)$

Problem 13. In our class, we assume that ARMA processes are constructed from a sequence of random shocks a_t which are (1) and have a (2) distribution with mean (3) and variance (4) .

Select the best choice to fill each of the numbered blanks above.

Blank (1):	\mathbf{a}) \star indep	b) correlated		
Blank (2):	\mathbf{a}) t	\mathbf{b}) chi-square	C	$c)\star$ normal
Blank (3):	\mathbf{a})* 0	b) 1		$\mathbf{c}) \hspace{0.1 cm} \mu_z$
Blank (4):	\mathbf{a}) $\star \sigma_a^2$	b) σ_z^2	c) 0	d) 1

Problem 14. Suppose you are applying a regression model to data and the errors exhibit serial correlation, but the other regression assumptions are valid. Which one of the following items in the regression output might be seriously in error?

a) the leverage and Cook's D values	b) the regression estimates $\hat{\beta}_i$
\mathbf{c}) the residuals and fitted values	d) \star the standard errors of the $\hat{\beta}_i$'s
e) the R-Square value	\mathbf{f}) the error degrees of freedom

Problem 15. In PROC ARIMA the statement

ESTIMATE P=3;

will fit which of the following models?

$\mathbf{a}) \star \ z_t = C + \phi_1 z_{t-1} + \phi_2 z_{t-2} + \phi_3 z_{t-3} + a_t$	b) $z_t = C + \phi_3 z_{t-3} + a_t$
c) $z_t = C - \theta_1 a_{t+1} - \theta_2 a_{t+2} - \theta_3 a_{t+3} + a_t$	$\mathbf{d}) \ z_t = C - \theta_3 a_{t-3} + a_t$
e) $z_t = C + \phi_1 a_{t-1} + \phi_2 a_{t-2} + \phi_3 a_{t-3} + a_t$	f) $z_t = C + \phi_3 a_{t-3} + a_t$
g) $z_t = C + \phi_1 z_{t+1} + \phi_2 z_{t+2} + \phi_3 z_{t+3} + a_t$	$\mathbf{h}) \ z_t = C - \theta_3 a_{t+3} + a_t$

Problem 16. If you are applying regression to data which _____, you should use the Durbin-Watson test.

a) contains high leverage cases	b) contains outliers
\mathbf{c}) \star is time ordered	d) is not normally distributed
\mathbf{e}) contains influential cases	f) has many covariates

Problem 17. A random sample of size n individuals is drawn from a population of N individuals. The values of X (height) are measured for these n individuals, and these values are used to compute s_x^2 , the sample variance. The sample variance is an estimate of the population variance. The formula for the **population** variance is $\sigma_x^2 =$ ______.

$$\mathbf{a}) \ \frac{1}{n} \sum_{i=1}^{n} (X_i - \mu_x)^2 \text{ with } \mu_x = \frac{1}{n} \sum_{i=1}^{n} X_i \qquad \mathbf{b}) \ \frac{1}{N} \sum_{i=1}^{N} |X_i - \mu_x| \text{ with } \mu_x = \frac{1}{N} \sum_{i=1}^{N} X_i \\ \mathbf{c}) \ \frac{1}{n-1} \sum_{i=1}^{n} (X_i - \overline{X})^2 \text{ with } \overline{X} = \frac{1}{n} \sum_{i=1}^{n} X_i \qquad \mathbf{d}) \star \ \frac{1}{N} \sum_{i=1}^{N} (X_i - \mu_x)^2 \text{ with } \mu_x = \frac{1}{N} \sum_{i=1}^{N} X_i \\ \mathbf{e}) \ \frac{1}{n-1} \sum_{i=1}^{n} |X_i - \overline{X}| \text{ with } \overline{X} = \frac{1}{n} \sum_{i=1}^{n} X_i \qquad \mathbf{f}) \ \frac{1}{n} \sum_{i=1}^{n} |X_i - \mu_x| \text{ with } \mu_x = \frac{1}{n} \sum_{i=1}^{n} X_i \end{aligned}$$

Problem 18. Let $\rho_1, \rho_2, \rho_3, \ldots$ and $\phi_{11}, \phi_{22}, \phi_{33}, \ldots$ be the ACF and PACF, respectively, of a stationary ARMA process. The value of ϕ_{44} may be expressed as a function of _____.

a)
$$\hat{\phi}_{44}$$
 b) ρ_4 c) $\phi_{11}, \phi_{22}, \phi_{33}$ d) $\star \rho_1, \rho_2, \rho_3, \rho_4$
e) $\hat{\phi}_{11}, \hat{\phi}_{22}, \hat{\phi}_{33}$ f) $\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4$ g) $\hat{\rho}_4$ h) ρ_4, ρ_5, ρ_6

Problem 19. In a regression model, let $\hat{\beta}_i$ be the parameter estimate, t_i be the *t*-value, and $SE(\hat{\beta}_i)$ be the standard error corresponding to the covariate X_i . If _____, we may decide to drop X_i from the regression model.

a) $|t_i|$ is largeb) $\star |t_i|$ is smallc) t_i is large and positived) t_i is large and negativee) t_i is negativef) t_i is positiveg) $|SE(\widehat{\beta}_i)|$ is smallh) $|SE(\widehat{\beta}_i)|$ is largei) $SE(\widehat{\beta}_i)$ is large and positivej) $SE(\widehat{\beta}_i)$ is large and negativek) $SE(\widehat{\beta}_i)$ is negativel) $SE(\widehat{\beta}_i)$ is positive

Problem 20. Which of the following is another way to write an MA(3) process?

$$\begin{array}{ll} \mathbf{a}) & \widetilde{z}_{t} = \psi_{1} z_{t-1} + \psi_{2} z_{t-2} + \psi_{3} z_{t-3} \\ \mathbf{b}) & \widetilde{z}_{t} = C + \psi_{1} a_{t+1} + \psi_{2} a_{t+2} + \psi_{3} a_{t+3} \\ \mathbf{c}) & \widetilde{z}_{t} = C + \psi_{1} a_{t-1} + \psi_{2} a_{t-2} + \psi_{3} a_{t-3} \\ \mathbf{e}) & \widetilde{z}_{t} = a_{t} + \psi_{1} \widetilde{z}_{t-1} + \psi_{2} \widetilde{z}_{t-2} + \psi_{3} \widetilde{z}_{t-3} \\ \mathbf{g}) & \widetilde{z}_{t} = \psi_{0} a_{t} + \psi_{1} a_{t+1} + \psi_{2} a_{t+2} + \psi_{3} a_{t+3} \\ \end{array}$$

$$\begin{array}{l} \mathbf{b}) & \widetilde{z}_{t} = C + \psi_{1} a_{t+1} + \psi_{2} a_{t+2} + \psi_{3} a_{t+3} \\ \mathbf{d}) & \widetilde{z}_{t} = C + \psi_{1} a_{t+1} + \psi_{2} a_{t+2} + \psi_{3} a_{t+3} \\ \mathbf{d}) & \widetilde{z}_{t} = \psi_{0} a_{t} + \psi_{1} a_{t-1} + \psi_{2} a_{t-2} + \psi_{3} a_{t-3} \\ \end{array}$$

Problem 21. A stationary AR(1) process $\{z_t\}$ has variance equal to $Var(z_t) =$ _____.

a)
$$\frac{C}{1-\phi_1}$$
 b) $\frac{C^2}{1-\phi_1^2}$ **c**) $\frac{C}{1-\phi_1^2}$ **d**) $\frac{\sigma_a^2}{1-\phi_1}$ **e**) $\frac{\sigma_a}{1-\phi_1}$ **f**) $\star \frac{\sigma_a^2}{1-\phi_1^2}$

Problem 22. If $\{z_t\}$ is an MA(6) process, then $Cov(z_t, z_{t-4}) =$ _____.

$$\begin{array}{ll} \mathbf{a}) & \sigma_z^2 \left(\psi_0 \psi_4 + \psi_1 \psi_5 + \psi_2 \psi_6 \right) & \mathbf{b} \right) & \sigma_z^2 \left(\psi_1 \psi_5 + \psi_2 \psi_6 \right) \\ \mathbf{c}) & \sigma_a^2 \left(\psi_0 \psi_6 + \psi_1 \psi_7 + \psi_2 \psi_8 + \psi_3 \psi_9 \right) & \mathbf{d} \right) & \sigma_z^2 \left(\psi_0 \psi_6 + \psi_1 \psi_7 + \psi_2 \psi_8 + \psi_3 \psi_9 \right) \\ \mathbf{e}) & \sigma_a^2 \left(\psi_1 \psi_7 + \psi_2 \psi_8 + \psi_3 \psi_9 + \psi_4 \psi_{10} \right) & \mathbf{f} \right) & \sigma_z^2 \left(\psi_1 \psi_7 + \psi_2 \psi_8 + \psi_3 \psi_9 + \psi_4 \psi_{10} \right) \\ \mathbf{g}) & \sigma_a^2 \left(\psi_1 \psi_5 + \psi_2 \psi_6 \right) & \mathbf{h} \right) \star & \sigma_a^2 \left(\psi_0 \psi_4 + \psi_1 \psi_5 + \psi_2 \psi_6 \right) \\ \end{array}$$

Problem 23. For a time series z_t , the graphs below are scatterplots of z_{t-1} versus z_t (top left), z_{t-2} versus z_t (top right), z_{t-3} versus z_t (bottom left), and z_{t-4} versus z_t (bottom right). Based on these plots, the values of r_1 , r_2 , r_3 , r_4 are approximately equal to _____.

a) 5, 5, 5, 5
b) .95, .3, -.1, -.9
c) -.8, -.3, .1, .5
d)
$$\star$$
 .8, .3, -.1, -.5
e) .8, -.7, -.1, -.2
f) 6.7, 6.7, 6.7, 6.7
 $\overset{\circ}{}_{0}$
 $\overset{\circ}{}_{0}$

z

z

Problem 24. If a process $z_1, z_2, z_3, ...$ is _____.

- a) second order stationary, then the ACF might change over time
- **b**) strictly stationary, then the ACF might change over time
- (\mathbf{c}) * strictly stationary, then it will also be second order stationary
- d) second order stationary, then it will also be strictly stationary
- e) second order stationary, then it canNOT be weakly stationary
- f) weakly stationary, then it can**NOT** be second order stationary

Problem 25. By repeated substitution, the process $z_t = \phi_1 z_{t-1} + a_t$ with $|\phi_1| < 1$ can be re-written as _____.

$$\mathbf{a}) \ z_{t} = a_{t} + \sum_{i=1}^{\infty} \phi_{1} a_{t-i}$$

$$\mathbf{b}) \ z_{t} = a_{t} + \sum_{i=1}^{\infty} \phi_{1} z_{t-i}$$

$$\mathbf{c}) \ z_{t} = a_{t} + \phi_{1} z_{t-1} + \phi_{1}^{2} a_{t-2}$$

$$\mathbf{d}) \ z_{t} = a_{t} + \phi_{1} z_{t-1} + \phi_{1}^{2} a_{t-2} + \phi_{1}^{3} a_{t-3}$$

$$\mathbf{e}) \ z_{t} = a_{t} - \phi_{1} z_{t-1} - \phi_{1}^{2} a_{t-2}$$

$$\mathbf{f}) \ z_{t} = a_{t} - \phi_{1} z_{t-1} - \phi_{1}^{2} a_{t-2} - \phi_{1}^{3} a_{t-3}$$

$$\mathbf{g}) \star \ z_{t} = a_{t} + \sum_{i=1}^{\infty} \phi_{1}^{i} a_{t-i}$$

$$\mathbf{h}) \ z_{t} = a_{t} + \sum_{i=1}^{\infty} \phi_{1}^{i} z_{t-i}$$

Problem 26. In our usual notation, an ARMA(p,q) process is defined by _____

a) $z_t = C + \phi_1 a_{t+1} + \dots + \phi_p a_{t+p} + a_t - \theta_1 z_{t+1} - \dots - \theta_q z_{t+q}$ b) $z_t = C - \phi_1 z_{t+1} - \dots - \phi_p z_{t+p} + a_t + \theta_1 a_{t+1} + \dots + \theta_q a_{t+q}$ c) $z_t = C - \phi_1 a_{t+1} - \dots - \phi_p a_{t+p} + a_t + \theta_1 z_{t+1} + \dots + \theta_q z_{t+q}$ d) $z_t = C + \phi_1 z_{t+1} + \dots + \phi_p z_{t+p} + a_t - \theta_1 a_{t+1} - \dots - \theta_q a_{t+q}$ e) $z_t = C + \phi_1 a_{t-1} + \dots + \phi_p a_{t-p} + a_t - \theta_1 z_{t-1} - \dots - \theta_q z_{t-q}$ f) $z_t = C - \phi_1 z_{t-1} - \dots - \phi_p z_{t-p} + a_t + \theta_1 a_{t-1} + \dots + \theta_q a_{t-q}$ g) $z_t = C - \phi_1 a_{t-1} - \dots - \phi_p a_{t-p} + a_t + \theta_1 z_{t-1} + \dots + \theta_q z_{t-q}$ h)* $z_t = C + \phi_1 z_{t-1} + \dots + \phi_p z_{t-p} + a_t - \theta_1 a_{t-1} - \dots - \theta_q a_{t-q}$

Problem 27. Suppose $\{a_t\}$ is a sequence of random shocks. What is the value of

$$E\left[(2a_2+3a_3+4a_4)(3a_1+4a_2)\right]$$
?

a)
$$63\sigma_z^2$$
 b) $16\sigma_z^2$ **c)** $8\sigma_z^2$ **d)** $18\sigma_z^2$ **e)** 0

f) $63\sigma_a^2$ **g**) $16\sigma_a^2$ **h**)* $8\sigma_a^2$ **i**) $18\sigma_a^2$ **j**) 1

Problem 28. The four scatter plots given below depict four samples of size 200. In two of these plots, the sample correlation between X and Y is exactly zero. Which two plots are these?

a) 1, 2 b) 1, 3 c) 1, 4 d) 2, 3 e)
$$\star$$
 2, 4 f) 3, 4



Problem 29. Suppose $\{z_t\}$ is a stationary ARMA process generated using the sequence of random shocks $\{a_t\}$. The expression

$$E\left[\left(5\tilde{z}_{t-1}+a_t\right)\tilde{z}_{t-3}\right]$$

can be shown to be equal to _____.

$\mathbf{a}) \ 5\rho_2 + \sigma_a^2$	b) $5\rho_2 + \sigma_z^2$	\mathbf{c}) 5 $ ho_2$	d) $25\rho_2$	e) $25\rho_2^2$
f) $5\gamma_2 + \sigma_a^2$	$\mathbf{g}) \ 5\gamma_2 + \sigma_z^2$	\mathbf{h})* 5 γ_2	i) $25\gamma_2$	j) $25\gamma_2^2$

Problem 30. The SAS output on the next page gives the usual output produced by the IDENTIFY statement in PROC ARIMA for a series **z1** of length 200. Based on this output, a reasonable model for this series is _____

a) MA(4)b) MA(3)c) MA(2)d) \star AR(2)e) AR(1)f) AR(3)g) ARMA(2,3)h) ARMA(2,2)i) ARMA(1,3)j) ARMA(1,1)



Problem 31. Suppose a random sample of n individuals has values of X and Y given by $(X_1, Y_1), (X_2, Y_2,), \ldots, (X_n, Y_n)$. If the sample correlation r between X and Y is **exactly** equal to 1, then the n points $(X_1, Y_1), (X_2, Y_2), \ldots, (X_n, Y_n)$ _____.

- a) lie in a band of constant width centered about zero.
- **b**) lie in a band of constant width centered about one.
- (\mathbf{c}) the exactly on a line with positive slope
- d) lie exactly on a line with slope equal to one
- e) are very close to a line with slope exactly equal to one
- \mathbf{f}) are very close to a line with positive slope
- **g**) are very close to the regression line $Y = \beta_0 + \beta_1 X + \varepsilon$

Problem 32. The log of the Lynx time series exhibits oscillations of a somewhat periodic nature. Which of the following time series models (with an appropriate choice of parameter values) is also capable of exhibiting somewhat periodic oscillatory behavior?

a) random shocks b) MA(1) c) AR(1) d) MA(2) e) \star AR(2)

Problem 33. SAS PROC ARIMA was used to fit an AR(1) and an MA(3) model to a time series. The two tables given below are extracted from the output produced by the ESTIMATE statement for these two models. The left table was produced when fitting the AR(1) model; the right table was produced when fitting the MA(3) model.

Suppose you relied on the AIC or SBC to choose between these two models. Which of the following statements is true?

- \mathbf{a}) \star AIC selects MA(3); SBC selects AR(1)
- **b**) AIC selects AR(1); SBC selects MA(3)
- c) Both AIC and SBC select AR(1)
- d) Both AIC and SBC select MA(3)
- e) Both AIC and SBC reject the null hypothesis
- f) Neither AIC or SBC reject the null hypothesis

Constant Estimate	4.586857
Variance Estimate	27.1341
Std Error Estimate	5.20904
AIC	1230.079
SBC	1236.676
Number of Residuals	200

Output from fitting AR(1) model

Output from fitting MA(3) model

Constant Estimate	10.13516
Variance Estimate	26.55393
Std Error Estimate	5.153051
AIC	1227.85
SBC	1241.043
Number of Residuals	200

Problem 34. For estimating the parameters of an ARMA process, if the shocks a_t are independent and approximately normally distributed with mean zero and constant variance, the preferred method of estimation is _____.

a) the default	b) AIC	\mathbf{c}) SBC	d) OLS	\mathbf{e}) CLS	f) ULS	\mathbf{g}) \star ML
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Problem 35. The process $z_t = 10 + a_t + .8a_{t-1} - .5a_{t-2}$ has coefficient values _____.

a) $\phi_1 = .8, \phi_2 =5$	b) $\phi_1 = .8, \phi_2 = .5$
c) $\theta_1 =8, \theta_2 =5$	$\mathbf{d}) \star \ \theta_1 =8, \theta_2 = .5$
e) $\theta_1 = .8, \theta_2 =5$	f) $\theta_1 = .8, \theta_2 = .5$
g) $\phi_1 =8, \phi_2 =5$	h) $\phi_1 =8, \phi_2 = .5$