

DO NOT TURN TO THE NEXT PAGE UNTIL YOU ARE INSTRUCTED TO DO SO!

The following exam consists of FOUR problems for a total of 175 points. Please keep three decimal points in all of your computations. To get credits, you are required to provide computational details such as providing equations, models, procedures, and explanations for related questions. You will have 75 minutes to complete the test. This means that you have, on average, about 20 minutes for each problem or four minutes for per question.

1. Write down (PRINT) your name in the blank space provided on the top right corner on this page.
2. This test is closed book and closed notes. You may bring ONE 8" x 11" note card or equation sheet (One side only). You can write or type anything on the card or sheet. You have to hand it in along with your test paper.
3. Partial credits are available and unsupported answers will not receive any credit even though they may be correct.
4. You are expected to remain in the classroom until you have turned in your test paper. You could not get your test paper back once you turn it in.
5. You must have your own calculator for the test. You cannot use pocket PC, cell phone, PDA, or anything like these for your test. You cannot share calculator with anyone.
6. If you believe that someone sitting near you is cheating, raise your hand and quietly inform a teacher of this. We'll keep an eye peeled, and your anonymity will be respected.
7. If any question seems unclear or ambiguous to you, raise your hand, and your teacher will attempt to clarify it. Or just put it on your test booklet, I will look at it when I grade the test.

Pledge: On my honor as a JMU student, I pledge that I have neither given nor received any unauthorized assistance on this examination.

Signature _____

1. You are working for Caveat Emptor, Inc., a home inspection service that provides prospective home buyers with a thorough assessment of the major systems in a house prior to the execution of the purchase contract. You are asked to forecast the average monthly heating cost with the information given below.

Table 1. Average Monthly Heating Costs and Forecasts

	A	B	C	D	E	F	G	H
		Avg Heating Cost						
1	Month		SMA2	WMA3	EXP(0.3)			Weights
2	12	96					w3	0.10
3	13	187					w2	0.40
4	14	235					w1	0.50
5	15	138					sum=	1.00
6	16	71						
7	17	206			127.117		alpha (α)	0.30
8	18							
9	19							

- (1) (5 pts) What is the two – period simple moving average forecast (SMA2) for the average heating cost of the home in the month 19? (must show the equation and the process for your answer)

- (2) What is the three – period weighted moving average forecast (WMA3) for the average heating cost of the home in the month 19 using the weights 0.5, 0.4 and 0.1 with the largest weight for the most recent month and the smallest weight for the remote month?
 - a. (6 pts.) What is the equation to be used?

 - b. (6 pts.) What is the Excel@ formula to be used for in Cell D9?

 - c. (3 pts.) What is the answer for it? (must show details by putting numbers in the equation and derive the answer)

- (3) What is the Exponential smooth forecast for Month 19 using α value of 0.3?
 - a. (5 pts.) What is the equation to be used? (only equation, no need to put any numbers in the equation)

 - b. (5 pts.) What is the Excel@ formula to be used for it in Cell E9?

- c. (3 pts.) What is the answer for it? (must show details by putting numbers in the equation and derive the answer)

Table 2. MSE and MAD(or MAE) of SMA2

	A	B	C	D	E	F	G
1	Month	Avg Heating Cost	SMA2				
2	4	230	323.00				
3	5	121	260.50				
4	6	250	175.50				
5	7	360	185.50				
6	8	164	305.00				
7	9	42	262.00				
8	10	90	103.00				
9							
10	MSE =						

- (4) As in Table 2 above, how to compute the Mean Squared Error (MSE) for the two – period simple moving average forecast (SMA2) for months 4 to 10?

- a. (6 pts.) What is the equation to be used? (only equation, no need to put any numbers in the equation)

- b. (6 pts.) What is the Excel@ formula to be used for it in Cell C10?

- (5) Use the data of the average heating costs and the two – period simple moving average forecasts in Table 2, assume the column F in Table 2 is used to compute the absolute forecasting error from months 9 to 10, answer the following questions:

- a. (6 pts) What is the equation to be used to compute Mean Absolute Deviation (MAD or MAE)?

- b. (6 pts) What is the MAD for months 9 to 10? (must show details and keep at least three decimal points)

-----END of Monthly Heating Cost Forecasting with SMA, WMA and EXP -----

2. Table 3 below shows the Summary Output for using regression analysis to forecast the average heating costs as the function of the square footage. Answer the following questions based on the information provided in Table 3.

Table 3. Simple Linear Regression Analysis for Average Heating Costs

	A	B	C	D	E	F	G
1	SUMMARY OUTPUT						
2							
3	<i>Regression Statistics</i>						
4	Multiple R	0.941					
5	R Square	0.886					
6	Adjusted R Square	0.880					
7	Standard Error	36.679					
8	Observations	20					
9							
10	ANOVA						
11		<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
12	Regression	1	188773.7301	188773.73	140.31	6.2158E-10	
13	Residual	18	24216.46995	1345.36			
14	Total	19	212990.2				
15							
16		<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
17	Intercept	-183.603	33.791	-5.433	3.669E-05	-254.596	-112.610
18	Square Footage	0.195	0.016	11.845	6.216E-10	0.161	0.230
19							
20	RESIDUAL OUTPUT						
21							
22	Home	Square Footage	Avg Heating Cost	Predicted Avg Heating			
23	1	1900	198				
24	2	2800	355				
25	3	2500	291				
26	4	2000	230				
27	5	1300	121				
28	6	2100	250				
29	7	2400	360				
30	8	2300	164				
31	9	1300	42				
32	10	1500	90				
33	11	2300	271				
34	12	1400	96				
35	13	1900	187				
36	14	2100	235				
37	15	1800	138				
38	16	1200	71				
39	17	2000	206				
40	18	2900	398				
41	19	2600	319				
42	20	1500	72				
43							
44		2200					
45		500					

(1) (10 pts.) What is the general linear model to be used to model the linear trend for the average heating cost as the function of square footage of the house?

(2) Answer the following two questions:

a. (2 pts) What is the estimated value of b_1 ,

b. (4 pts) How do you interpret the meaning of b_1 ?

(3) You are asked to predict the average heating cost for a house with the size of 2,200 square footage:

a. (6 pts.) What is the Excel@ formula of the estimated regression function in Cell D44 of Table 3?

b. (3 pts.) What is the predicted average heating cost for a house with the size of 2,200 square footage? (show details)

(4) (3pts) You are asked to predict the average heating cost for a house with the size of 500 square footage, discuss how you would approach the problem and why?

SUMMARY OUTPUT		Table 4	
<i>Regression Statistics</i>			
Multiple R	0.953		
R Square	0.908		
Adjusted R Square	0.891		
Standard Error	34.985		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-152.037	39.547	-3.844	0.001	-235.873	-68.202
Attic Insulation (inches)	-4.892	3.328	-1.470	0.161	-11.947	2.162
Age of Furnace (years)	3.699	2.680	1.380	0.186	-1.982	9.379
Square Footage	0.182	0.018	10.227	2.01E-08	0.144	0.219

SUMMARY OUTPUT		Table 6	
<i>Regression Statistics</i>			
Multiple R	0.882		
R Square	0.778		
Adjusted R Square	0.737		
Standard Error	54.346		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	424.201	61.167	6.935	3.36E-06	294.533	553.869
Avg Outside Temp	-4.691	0.805	-5.829	2.57E-05	-6.397	-2.985
Attic Insulation (inches)	-14.152	5.187	-2.728	0.015	-25.143	-3.155
Age of Furnace (years)	5.310	4.148	1.280	0.219	-3.484	14.105

SUMMARY OUTPUT		Table 8	
<i>Regression Statistics</i>			
Multiple R	0.954		
R Square	0.910		
Adjusted R Square	0.893		
Standard Error	34.566		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-14.725	97.942	-0.150	0.882	-222.352	192.902
Square Footage	0.155	0.029	5.254	7.87E-05	0.092	0.217
Avg Outside Temp	-1.319	0.861	-1.531	0.145	-3.145	0.508
Attic Insulation (inches)	-6.841	3.604	-1.898	0.076	-14.482	0.799

SUMMARY OUTPUT		Table 10	
<i>Regression Statistics</i>			
Multiple R	0.948		
R Square	0.898		
Adjusted R Square	0.879		
Standard Error	36.879		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-139.683	85.374	-1.636	0.121	-320.667	41.301
Age of Furnace (years)	3.149	2.850	1.105	0.286	-2.893	9.191
Square Footage	0.172	0.029	5.908	2.2E-05	0.110	0.234
Avg Outside Temp	-0.437	0.846	-0.587	0.565	-2.290	1.297

SUMMARY OUTPUT		Table 5	
<i>Regression Statistics</i>			
Multiple R	0.982		
R Square	0.964		
Adjusted R Square	0.901		
Standard Error	47.076		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.000	#N/A	#N/A	#N/A	#N/A	#N/A
Attic Insulation (inches)	-12.287	3.654	####	0.004	-19.996	-4.578
Age of Furnace (years)	3.727	3.606	1.034	0.316	-3.881	11.334
Square Footage	0.130	0.016	####	2.07E-07	0.097	0.163

SUMMARY OUTPUT		Table 7	
<i>Regression Statistics</i>			
Multiple R	0.905		
R Square	0.820		
Adjusted R Square	0.740		
Standard Error	105.526		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.000	#N/A	#N/A	#N/A	#N/A	#N/A
Avg Outside Temp	-0.472	1.023	####	0.651	-2.630	1.687
Attic Insulation (inches)	7.297	8.087	####	0.380	-9.765	24.358
Age of Furnace (years)	24.998	5.874	####	0.001	12.606	37.390

SUMMARY OUTPUT		Table 9	
<i>Regression Statistics</i>			
Multiple R	0.991		
R Square	0.982		
Adjusted R Square	0.921		
Standard Error	33.557		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.000	#N/A	#N/A	#N/A	#N/A	#N/A
Square Footage	0.150	0.008	####	1.42E-12	0.133	0.168
Avg Outside Temp	-1.437	0.334	####	0.0005	-2.141	-0.733
Attic Insulation (inches)	-7.162	2.822	####	0.0212	-13.116	-1.207

SUMMARY OUTPUT		Table 11	
<i>Regression Statistics</i>			
Multiple R	0.988		
R Square	0.976		
Adjusted R Square	0.914		
Standard Error	38.655		
Observations	20.000		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.000	#N/A	#N/A	#N/A	#N/A	#N/A
Age of Furnace (years)	2.405	2.949	0.816	0.426	-3.817	8.627
Square Footage	0.128	0.012	####	5.24E-09	0.103	0.153
Avg Outside Temp	-1.766	0.353	####	0.0001	-2.512	-1.021

(5) Tables 4 to 11 show the Summary Output tables for the regression model to predict the average heating cost (Y) as a function of the average outside temperature in winter (X_1), the amount of attic insulation in the house (X_2), the age of the furnace in the house (X_3), and the size of the house measured in square feet (X_4). If the company wanted to build a regression model using only THREE independent variables out of the four to predict the average heating cost of these houses, what variables should be used? What is the criterion used in your choice?

a. (5 pts) What variables should be used and why? Show the detailed reasoning process to your conclusion in each step of the whole process.


b. (5 pts) What is the criterion used in your choice in each step of your reasoning process?

----- **END of Heating Cost Regression Analysis** -----

3. One hundred doctors were asked this hypothetical question: In a routine examination, you find a lump in a female patient's breast. In your experience, only 1 out of 100 such lumps turns out to be malignant; but to be safe, you order a mammogram X ray. If the lump is malignant, there is a 0.80 probability that the mammogram will

identify it as malignant; if the lump is benign, there is a 0.90 probability that the mammogram will identify it as benign. In this particular case, the mammogram identifies the lump as malignant. In light of these mammogram results, what is your estimate of the probability that this lump is malignant? You may use the following table to facilitate your answers. Please keep 3-decimal points of accuracy and show details for each type of probabilities with equations and appropriate notations.

Table 12. Probabilities

	A	B	C	D	E	F	G
1							
2	Prior Probability						
3							
4	Conditional Probability						
5							
6							
7							
8							
9							
10	Joint Probability						
11							
12							
13							
14							
15							
16	Posterior Probability						
17							
18							
19							
20							
21							

4. The Gorman Manufacturing Company must decide whether to make a component part P at its own plant or to purchase the component part P from a supplier. The resulting profit is dependent upon the demand for the product. The following payoff table shows the projected profit (in thousands of dollars).

Table 13. Payoff Table

	A	B	C	D	E	F
1		LowDemand	MediumDemand	HighDemand		
2	Make P	-20	40	100		
3	Purchase P	10	45	70		
4						

Based on their experience, the probabilities of low and high demands are 0.10 and 0.50 respectively.

- (1) You must show details with appropriate equations and terms and keep 3 decimal points.
- (6 pts) Use the payoff table and other information available to compute the expected monetary values (EMV) and Max EMV.
 - (8 pts) Construct the decision tree to find the expected monetary values (EMV) and Max EMV for the problem. Each branch and node of the tree should be clearly labeled with its name, payoff, probability, and any results derived from its subsequent nodes and branches. You could refer to existing results either given or derived for previous questions without redo them again.
 - (4 pts.) What is the maximum or optimal expected profit (EMV) = _____? (You must show details. You could refer to existing results either given or derived for previous questions without redo them again.)

d. (4 pts.) What is the optimal strategy for the vendor and why?

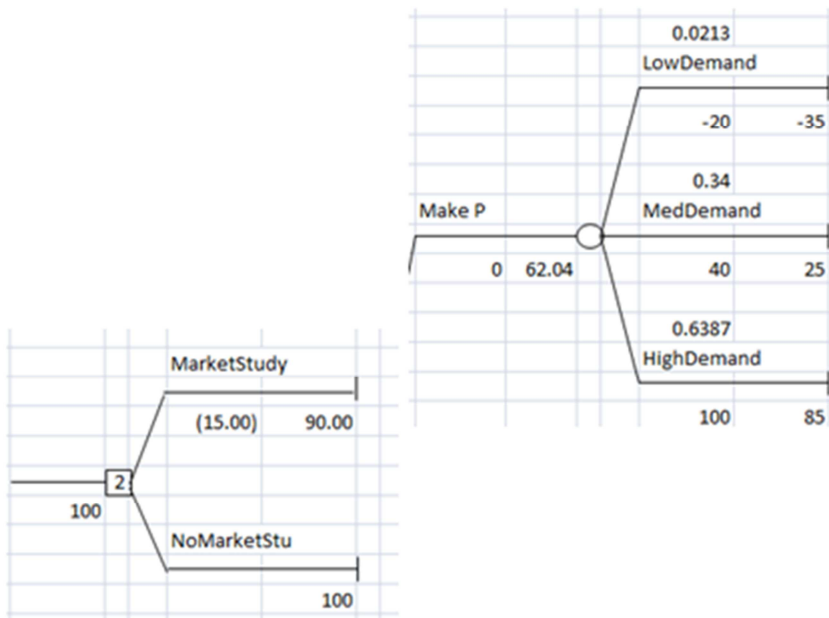
(2). What are the Expected Value with Perfect Information (EVwPI) and the Expected Value of Perfect Information (EVPI)?

a. (8 pts) Construct the decision tree to find the Expected Value with Perfect Information (EVwPI) for the problem. Each branch and node of the tree should be clearly labeled with its name, payoff, probability, and any results derived from its subsequent nodes and branches. You could refer to existing results either given or derived for previous questions without redo them again.

b. (3 pts.) What is the Expected Value of Perfect Information (EVPI) for the problem? (You must show details)

(3) Do not use any information in previous problems. Given the portion of the expanded decision tree with a potential market research for the situation below, Assume the Company is asked to pay \$15 for a reliable market research report. You should use ONLY the information on this expanded decision tree. Assume EVwPI is \$110. No need to pull back the tree. For your convenience, you may see:

$$62.04 = -35 * 0.213 + 25 * 0.34 + 85 * 0.6387.$$



- a. (6 pts) Compute the Expected Value with Sample Information (EVwSI) and the Expected Value of Sample Information (EVSI) for the problem. You must show details.

- b. (4 pts) Computer the Expected Value of Perfect Information (EVPI). You should show details.

- c. (3 pts) Compute the efficiency of the sample information and discuss your findings. You must show details.

- d. (3 pts) What choice would you recommend to the Company for the whole situation (with or without the market research) and why?

- (4) With the Company information in Problem 4 reproduced here for convenience, suppose the following data are also available.

Table 13. Payoff Table

	A	B	C	D	E	F
1		LowDemand	MediumDemand	HighDemand		
2	Make P	-20	40	100		
3	Purchase P	10	45	70		
4						

Based on their experience, the probabilities of low and high demands are 0.10 and 0.50 respectively.

- a. (5 pts) Use the Payoff table, the probabilities, etc, to finish a sketch of Market Study portion of the expanded decision tree on the next page. It should include each branch and note as required.

Joint Probability				
	LowDemand	MediumDemand	HighDemand	
Favorable	0.01	0.16	0.3	0.47
UnFavorable	0.09	0.24	0.2	0.53
	0.1	0.4	0.5	
Posterior Probability				
	LowDemand	MediumDemand	HighDemand	
Favorable	0.021	0.340	0.638	
UnFavorable	0.170	0.453	0.377	

- a. (3 pts) Label appropriately the path of Market Research, High Demand, UnFavorable Report, and to Purchase P. Each branch and node of this portion of the tree should be clearly labeled with its name, payoff, and probability.

