— If submitting a "hard (paper) copy", staple this signed sheet as a cover —

Strayer University — Manassas Campus
Quantitative Methods — MAT540
— Fall 2005 —

Final Exam

This is a take-home (open text, open class-notes and open Student Guide) final exam. Read carefully the entire exam before attempting to solve any of the problems and then budget your time: do first what you know best. ***Show and submit <u>all your work</u> to justify your answers***; wherever appropriate, identify the given data, the applicable formulae, substitutions and results. *Neither discussion of this test with anyone other than the instructor, nor the use of materials other than the text, class notes or the student guide is permitted.* Give proper credit to any source or shortcut you may use. If using computer software to perform calculations, provide sufficient trace for an unambiguous determination of method. By submitting the exam by the **deadline, Wednesday, 03/22/06 7:15** PM, at the Academic Office of Strayer University of the Manassas Campus or by e-mail, you affirm that you have abided by these rules:

....

Student's full name

Good luck!

(And, may you need none at all!)

Pb.	Pts	Score	Instructor's Comment
1.	10		
2.	20		
3.	30		
4.	40		
Σ	**100**		

— If submitting a "hard (paper) copy", staple this signed sheet as a cover —

Problem 1. (10 points)

This table shows the distribution of average weekly study times for MAT450 students:

		Study time (hours/week)			
Number of		**< 1.0**	**1.0–1.5**	**1.5–2.0**	**>2.00**
Students:	**Female**	7	14	33	1
	Male	4	22	23	4

Calculate the probability that:

a. any one of the students, regardless of gender, studies > 1.5 hrs/week.

b. any one of the students in this class is male.

c. any two of the students (of undetermined gender) each studies > 1.5 hrs/week.

d. any one male and any one female student each study > 1.5 hrs/week.

e. a student is male, provided that the student studies > 1.5 hrs/week.

f. a student is both male and studies > 1.5 hrs/week.

Problem 2. (20 points)

The *AutoMotors, Inc.* must decide whether to manufacture a part or to purchase it from a supplier. The resulting profits depend upon the demand on the end product, as shown in the payoff table:

(in $1,000's)	**Low Demand**	**Medium Demand**	**High Demand**
Decision Alternative	**S1**	**S2**	**S3**
Manufacture, D1	– 15	51	102
Purchase, D2	12	63	85

The probabilities for the different demands are: $P(\text{S1}) = 0.21$, $P(\text{S2}) = .35$ and $P(\text{S3}) = 0.44$.

a. Determine the decision based on the optimistic (*maximax*), conservative (*minimax*) and optimal regret approach. For the latter calculate and display the regret table.

b. Use a decision tree and expected values (per decision) to recommend a decision.

c. A market study of the potential demand is expected to report either a favorable (F) or an unfavorable (U) condition. The relevant conditional probabilities then are as follows:
$P(\text{F}\,|\,\text{S1}) = 0.13$, $P(\text{F}\,|\,\text{S2}) = 0.35$, $P(\text{F}\,|\,\text{S3}) = 0.62$,
$P(\text{U}\,|\,\text{S1}) = 0.87$, $P(\text{U}\,|\,\text{S2}) = 0.65$, $P(\text{U}\,|\,\text{S3}) = 0.38$.
Calculate the probability that the market research report will be favorable, $P(\text{F})$.

d. Describe *AutoMotors, Inc.*'s optimal strategy, using a decision tree diagram & above data.

e. Calculate the expected value of the market research information.

Problem 3. (30 points)

The following table shows the quarterly revenue (in $1,000's) from an office suite rental:

	2001	2002	2003	2004	2005
Q1	20.93	27.32	32.01	31.07	32.88
Q2	26.92	33.63	35.37	32.73	45.13
Q3	34.49	41.16	46.38	44.49	52.85
Q4	37.87	46.22	50.31	58.41	61.06

a. Using 4-quarter moving averages, predict the Q1/2006 revenue.

b. Using exponential smoothing, with $\alpha = 0.3$, predict the Q1/2006 revenue.

c. Adjust the analysis from part b., using $\beta = 0.25$, and predict the Q1/2006 revenue.

d. From the above data, determine the (unmodified) trend function, $T_t = b_0 + b_1 t$.

e. Determine first the *seasonal factors*, and then use them to adjust the trend function based forecasts for all four quarters of 2006.

f. Using MAD, compare the above prediction methods for the Q1/2006 revenue.

g. Calculate the *correlation coefficient* for the original data sequence, and state its meaning.

h. Try using the *seasonal factors* from part e. to adjust the predictions in parts a.–c.
(Recall the *meaning* of the seasonal factors and what sort of forecast do they multiply.)

Problem 4. (40 points)

Consider the linear programming model where the objective function $Z = 9 \cdot x + 6 \cdot y$, with $x, y \geq 0$, is to be maximized, subject to the four constraints:

$$(1)\ x - 3 \cdot y \leq 0\,, \quad (2)\ 7x + 8y \leq 280\,, \quad (3)\ 6 \cdot x + 9 \cdot y \leq 180\,, \quad (4)\ 3 \cdot x + 4 \cdot y \leq 120\,.$$

a. Carefully construct the feasible region *graphically* and calculate the coordinates of all corners. Draw the axes to scale (use graph paper or a plotting software).

b. Determine the optimal point and the value of Z at the optimal point either graphically or by computer—but show all work necessary to reach your conclusion.

c. Determine the slack/surplus value in each of the constraint for your solution to part b.

d. Determine the ranges within which the two coefficients in Z may vary without changing your result in part b.

e. Change constraint (1) into $x - 2 \cdot y \leq 0$ and (3) into $3 \cdot x + 6 \cdot y \leq 180$. Determine the effects on the feasible region, optimal point and the value of Z at the (new) optimal point.

f. With the linear programming model *changed in part e.*, restrict now x,y to be integers, and determine the optimal point(s), the value of Z and the slack/surplus for each constraint at the (new) optimal point(s).