EXAMINATION: MARKETING MODELS & ANALYSIS SS 2009
EXAMINER: PROF. DR. B. ERICHSON, NUMBER OF LECTURE: 2683

You are allowed to use a non-programmable pocket calculator without communication functions.
The answers to all questions should be made in one language, please use English or German.
All of the 7 exam questions must be answered (the estimated time for each question is given).
This examination has 4 pages.

Question 1: Models **(10 Min.)**

a) A Model can be defined as a **simplified representation of a part of reality**. Two purposes of models are **description** and **explanation**. Name two other purposes of models!

b) An important type of a model (for business as well as for economics) is a Market Response Function (MRF).

b1) Give two examples of dependent variables in MRFs!

b2) Independent variables in MRFs can be divided into controllable and uncontrollable variables. Give two examples of both!

c) What advantages arise from using models for decision making instead of "gut feelings"?

Question 2: Estimation **(10 Min.)**

a) Which estimation methods (principles) can be used for the calibration of models, i.e. fitting them to empirical data?

b) Nonlinear models are classified into **intrinsically linear models** and **intrinsically non-linear models**. Which of the following models are intrinsically linear?

b1) $Y = \alpha + \beta \cdot \sqrt{X} + u$ b2) $Y = \alpha \cdot X^{\beta} + u$

b3) $Y = \alpha \cdot X^{\beta} \cdot u$ b4) $Y = \alpha + \beta \cdot X^{\gamma} + u$

b5) $Y = 1 - \alpha \cdot e^{-\beta \cdot X + u}$ b6) $Y = M - \alpha \cdot e^{-\beta \cdot X} + u$

c) The following function can be used for modeling market share growth or response:

$$Y = \frac{100}{1 + e^{\alpha + \beta \cdot X + u}} [\%]$$ What is this function (model) called?

d) Try to linearize this model for estimation by linear regression!

Question 3: Nonlinear Regression **(5 Min.)**

In estimating **intrinsically non-linear models** no analytic solution is possible. Instead iterative numerical algorithms have to be used.

a) Which methods for nonlinear optimization do you know?

b) Iterative algorithms can degenerate (do not converge) or get stuck in a local optimum. How can you cope with these problems?

Question 4: Price Response Estimation **(10 Min.)**

A friend of you, who produces and sells a medical product, collected data on sales and price shown in the Excel spreadsheet below. Based on these data he estimates the following PRF by use of Excel solver:

$$Y = a \cdot P^{b} + u$$

a) Which estimation principle uses your friend?

Please, turn the page

b) Please specify in the solver window the
   - b1) target cell (objective function)
   - b2) target value (e.g. Min or Max)
   - b3) changing cells (estimation parameters)

c) The spreadsheet below already shows the result of the optimization. Please write down the estimated function!

d) Judge the goodness of fit of the estimated function (give the value of R-Square)!

Demand Model: $Y = a \cdot P^b + u$

A. Data and PRF Estimation

Parameter: a = 366,255; b = -2,348

	Sales y	Price p	a * p^b $\hat{y}$	$(y-\hat{y})^2$	Total Variation
	19,6	3,50	19,35	0,06	116,64
	5,1	6,00	5,46	0,13	13,69
	15,3	4,00	14,14	1,35	42,25
	4,3	7,00	3,80	0,25	20,25
	7,9	5,50	6,70	1,45	0,81
	9,2	4,80	9,22	0,00	0,16
	8,0	5,00	8,37	0,14	0,64
	4,1	6,50	4,52	0,18	22,09
	10,6	4,20	12,61	4,04	3,24
	3,9	7,20	3,56	0,12	24,01
Mean:	8,8	5,37	SSR =	7,71	SST = 243,78

R-Square = ???

B. Decision

Return	R =	p * y		
Cost	C =	Cf + k*y	with	Cf = 12,00
Profit	Profit =	R - C		k = 3,00

Calculation:

p	y	R	C	Profit

Question 5: Pricing Decision **(10 Min.)**

Your friend also wants to use the Excel spreadsheet above to support his pricing decision, that is to find the price that will **maximize profit**.

Assume: Fixed cost $C_f = 12$, variable cost per unit k = 3.

a) Please write down the target function!

b) Please specify in the solver window the

b1) target cell (objective function)

b2) target value (e.g. Min or Max)

b3) changing cell (decision variable)

c) Before your friend can find the solution by use of Excel solver alas his PC breaks down. Please help your friend to find the optimal price analytically!

(Help: Think of the Amoroso-Robinson-Relation $p^* = k \cdot \frac{\varepsilon}{\varepsilon + 1}$)

d) Compute the maximum profit!

Question 6: Advertising Decision **(10 Min.)**

The PowerMax company, producer of the well known energy drink, has estimated the following advertising response function by using regression analysis:

$$x_t = 500 + 400 \cdot \ln(w_t) + 0{,}6 \cdot x_{t-1}$$

with w_t = advertising budget in period t

x_t = sales in period t

current state: $w_0 = 1500$, $x_0 = 8563$ (steady state)

price per unit p = 5, variable cost per unit k = 3.

a) Calculate the **optimal short term advertising budget**!

b) Calculate the **optimal long-term advertising budget**! (neglect discounting)

c) You could also use the Excel spreadsheet below for supporting your advertising decision.

c1)Which cell would be the target cell for optimal short term advertising in period t=1?

c2)Which cell would be the target cell for optimal long term advertising in period t=1?

d) By which percentage increases sales in period t = 1 due to rising advertising by 33% (from 1500 to 2000)?

Please, turn the page

Advertising Decision for PowerMax

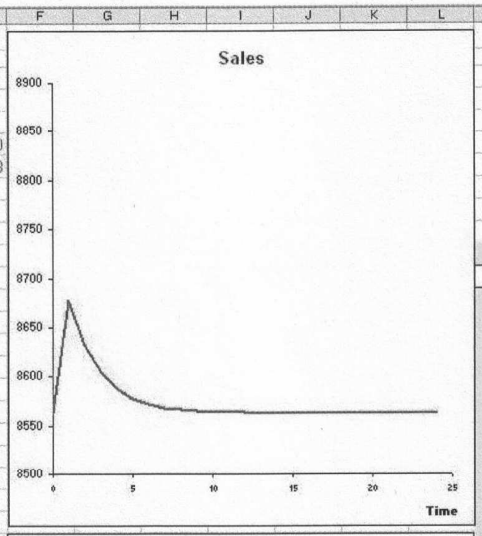
$x(t) = a + b * \ln(w(t)) + c * x(t-1)$

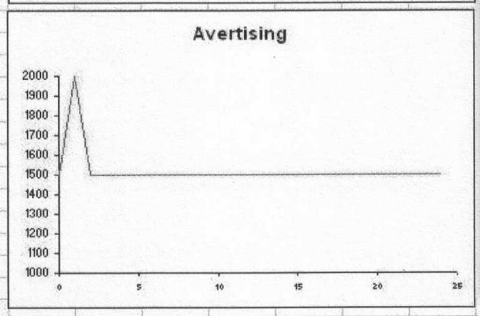
Parameter:

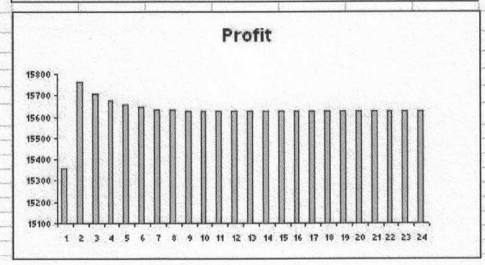
a =	500,00	w(0) =	1500
b =	400,00	steady state x =	8563
c =	0,60		

Model Simulation

t	w(t)	x(t)	x(t) - x (0)
0	1500	8563	
1	2000	8678	115
2	1500	8632	69
3	1500	8605	41
4	1500	8588	25
5	1500	8578	15
6	1500	8572	9
7	1500	8569	5
8	1500	8566	3
9	1500	8565	2
10	1500	8564	1
11	1500	8564	1
12	1500	8564	0
13	1500	8563	0
14	1500	8563	0
15	1500	8563	0
16	1500	8563	0
17	1500	8563	0
18	1500	8563	0
19	1500	8563	0
20	1500	8563	0
21	1500	8563	0
22	1500	8563	0
23	1500	8563	0
24	1500	8563	0
		Summe:	287,68







p =	5,00			
k =	3,00			
q =	1,00			

t	R(t)	C(t)	G_t R(t) - C(t)	$\frac{G_t}{q^{t-1}}$
0	42816	27190	15626	15626
1	43391	28035	15357	15357
2	43161	27397	15765	15765
3	43023	27314	15709	15709
4	42940	27264	15676	15676
5	42891	27234	15656	15656
6	42861	27217	15644	15644
7	42843	27206	15637	15637
8	42832	27199	15633	15633
9	42826	27195	15630	15630
10	42822	27193	15629	15629
11	42820	27192	15628	15628
12	42818	27191	15627	15627
13	42817	27190	15627	15627
14	42817	27190	15627	15627
15	42817	27190	15627	15627
16	42816	27190	15627	15627
17	42816	27190	15627	15627
18	42816	27190	15626	15626
19	42816	27190	15626	15626
20	42816	27190	15626	15626
21	42816	27190	15626	15626
22	42816	27190	15626	15626
23	42816	27190	15626	15626
24	42816	27190	15626	15626
		Summe:	375110	375110
				A

Question 7: Regression Analysis (5 Min.)

The cat food producer WhisCats has performed a regression analysis of sales on his marketing variables by using SPSS. The output is shown below:

	Sum of Squares	Durbin-Watson-Statistic:
Regression	1.204	1,9
Residuals	1.143	
Total	2.347	

predictors: events_with_Cats, price_per_can, promotion; dependent variable: Sales

coefficients	unstandardized coefficients	standardized coefficients		
	B	**Beta**	**t**	**Sign.**
(constant)	6,53			
price_per_can	-,27	-,17	-1,46	,152
promotion	,92	,36	2,76	,008
Events_with_Cats	,94	,35	2,74	,009

a) Write down the estimated function, and determine the global goodness of fit using R^2.

b) Check the significance of the estimated regression coefficients! (assume $\alpha = 5\%$)

c) Which marketing variable has the strongest impact on Sales?

Good Luck!