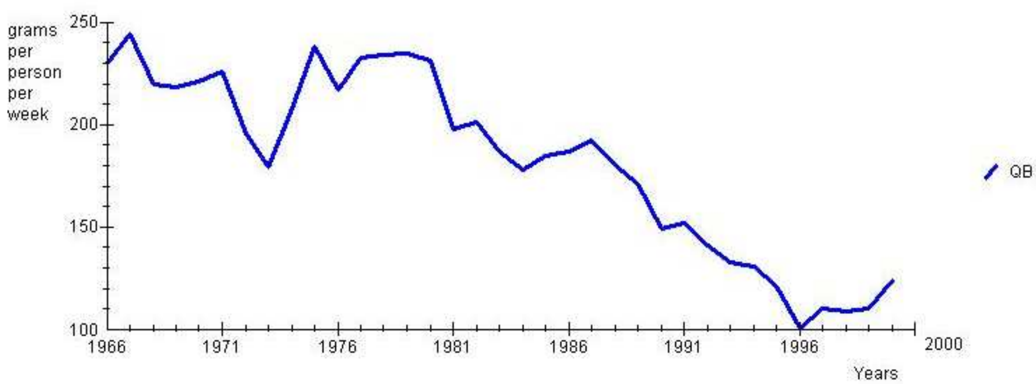
Modelling the Demand for Beef in United Kingdom in 1967 -1996

The meat has always been one of the basic food groups that most of us demand on the market. As we can see from *Graph 1* the consumption of one sort of meat, namely beef, during years 1967-2000 has a long-term downward sloping trend with the extensive variations in the first half of that period. How can we explain these fluctuations? Is there any reliable mathematical function by which means we could describe the demand for beef in the period 1967-1996? With the help of the econometric analysis program Microfit I tried to find an answer.

Graph 1 The demand for beef during years 1966-2000



In an attempt to explain the fluctuations I developed four alternative models for the chosen commodity in Microfit where I was using the Ordinary Least Squares method and the data for subperiod 1967-1996. The four models are listed below.

$$QB_t = \alpha + \beta_1 RPB_t + \beta_2 RPP_t + \beta_3 RPC_t + \beta_4 RDIPH_t + \beta_5 TIME + \varepsilon_t, \quad (1)$$

$$QB_t = \alpha + \beta_1 RPB_t + \beta_2 RPP_t + \beta_3 RPC_t + \beta_4 RDIPH_t + \beta_5 TIME + \beta_6 DUM96 + \varepsilon_t, \quad (2)$$

$$QB_t = \alpha + \beta_1 RPB_t + \beta_2 RPP_t + \beta_3 RPC_t + \beta_4 RDIPH_t + \beta_5 TIME + \beta_6 DUM96 + \beta_7 QB_{t-1} + \varepsilon_t, \quad (3)$$

$$QB_t = \alpha + \beta_1 RPB_t + \beta_2 RPP_t + \beta_3 RPC_t + \beta_4 RDIPH_t + \beta_5 TIME + \beta_6 DUM96 + \beta_7 QB_{t-1} + \beta_8 RPL_t + \varepsilon_t, \quad (4)$$

where:[1]

- *QB is consumption of beef, measured in grams per person per week;*
- *α is intercept*
- *RPP, RPC and RPL are the respective 'real' prices of pork, chic ken and lamb, measured in pence per kilogram in 1985 prices (the retail price index for all food, 1985 = 100, was used to obtain real prices);*
- *RDIPH is households' real disposable income per head (£, 1995 prices);*
- *TIME is a linear trend such that 1966 = 1, 1967 = 2, etc.;*
- *DUM96 is a binary variable equal to unity in 1996 and to zero in all other years;*
- *QB_{t-1} is the lagged value of the dependent variable*
- *ε is a random error term.*

The summary of my results for each model is presented in *Table 1* on the next page. There are three figures by each explanatory variable in the table – the first stands for regression coefficient, the second one in brackets is standard error and the figure written in bold type is t ratio.

[1] The basis for the list (glossary) is taken from the lecture handout "27th February 2006: More on Modelling Demand", p. 2-3

Table 1 The Demand for Beef in Great Britain 1967 –96

	(1)	(2)	(3)	(4)
Intercept	609.289 (56.173) **10.847**	576.863 (60.742) **9.497**	389.198 (98.701) **3.943**	308.041 (109.913) **2.803**
RPB	-0.346 (0.131) **-2.636**	-0.418 (0.141) **-2.969**	-0.363 (0.132) **-2.757**	-0.489 (0.153) **-3.203**
RPP	-0.417 (0.238) **-1.756**	-0.218 (0.280) **-0.779**	-0.095 (0.262) **-0.363**	-0.057 (0.256) **-0.223**
RPC	-0.115 (0.284) **-0.404**	-0.033 (0.287) **-0.116**	0.071 (0.267) **0.264**	0.220 (0.278) **0.792**
RDIPH	-0.015 (0.014) **-1.070**	-0.022 (0.015) **-1.466**	-0.018 (0.014) **-1.296**	-0.028 (0.015) **-1.860**
TIME	-3.668 (2.665) **-1.377**	-1.941 (2.944) **-0.659**	-0.722 (2.753) **-0.262**	1.195 (2.961) **0.404**
DUM96	-	-24.029 (18.486) **-1.300**	-24.299 (16.965) **-1.432**	-32.633 (17.385) **-1.877**
QB_{t-1}	-	-	0.353 (0.153) **2.304**	0.438 (0.159) **2.752**
RPL	-	-	-	0.354 (0.234) **1.513**
R^2	0.9074	0.9138	0.9305	0.9374
$\bar{R}^2$	0.8882	0.8913	0.9084	0.9135
RSS	4039.1	3762.7	3031.3	2733.4

For modelling I chose an approach which rests on developing general model from the specific one and in that way my aim was to increase an explanatory power of each subsequent regression. My initial model of demand contains of the product's own price, "RPB", (for this we would expect a negative sign of coefficient as we are assuming when the real price rises the demand is decreasing, ceteris paribus), the real prices of two principal substitutes – pork and chicken (RPP, RPC). I picked these two as they are probably the most available ones in "ordinary" shops. Since they are substitutes for beef we would anticipate the positive signs of their coefficients (as a price of product rises the demand for its substitute increases, cet.par.). Other regressor is real disposable income per head (RDIPH) because as "incomes rise the demand for most goods will rise"[2] (in case of normal goods), cet.par. The last explanatory variable in initial model stands for trend in consumers' preferences which is captured by a simple linear trend. Since there has been a general shift from consumption of red meat we can assume to get negative value of coefficient.

In an effort to improve the initial model I added other variables in models (2), (3) and (4). Model (2) includes an extra dummy variable[3] "DUM96" that takes into account shift from beef as a result of the BSE crisis in 1996 – consequently we can expect the coefficient β_5 to be negative. Model (3) has explanatory variable "QB_{t-1}" which takes into consideration some form of people's habit not to vary too much from what they consumed last year. The last model has extra variable "RPL" which is another substitute for beef. Anticipated sign of β_8 is therefore positive.

I consider regression (4) as the best one, even though there could be a lot of speculation about it. There are two points of view how to justify this decision. Firstly from the perspective of economic theory. Model (4) is an improvement on the initial regression

[2] Economics, John Sloman, p.32

[3] As it is called in the book Introduction to Econometrics, Christopher Dougherty, p.170

as it takes into accounts not only the 1996 crisis and consumption in previous year but also real price of lamb as another substitute, therefore having theoretically most determinants in relation to demand function. There are, however, dissonances between expected signs of coefficients and estimated values of Microfit's calculations. Positive sign of β_5 and negative sign of β_2 goes against economic theory and just indicates that meanwhile model (4) is probably the best one from our four regressions, there is still a lot to improve. Coefficient β_4 suggests then that beef is an inferior good. Note that sign divergences were found in other models as well.

From statistical perspective it is even less clear that model (4) is the best one. Even though the basic indicators of regression's "successfulness" – R^2 ("goodness of fit" or "coefficient of determination"[4]) and $\overline{R}^2$ ("adjusted R^2 "or "R-bar squared"[5]) – are the highest of the models, each additional variable brought just little improvement. This is partly due to already relatively high value of R^2 in model (1) and partly because some of the regressors are strongly correlated which makes them, statistically speaking, very similar variables (e.g. case of RDIPH and QB_{t-1} where k = -0.88317). However, overall the variables which were added to initial model do not seem to be too correlated with existing variables to cause extensive "multicollinearity"[6] and thereby it does not affect t ratios so much. Nevertheless, R^2=0.9374 is already very satisfactory goodness of fit as 93.74% of all variations in demand for beef in years 1967-1996 can be explained by variations in explanatory variables included in model (4). Probably the biggest shortcoming of the model are rather disappointing t-ratios which causes statistical uncertainty about the relevance of the variables. "We can test whether each coefficient is

[4] A Guide to Econometrics, Peter Kennedy, p.29
[5] Statistics for Economics, Accounting and Business Studies, Mike Barrow, p.249
[6] A Guide to Econometrics, Peter Kennedy, p.206

significantly different from zero i.e. whether the variable truly affects" [7] demand for lamb or not, using a conventional hypothesis t-test. Our null hypothesis is therefore Ho: $\beta_{1 \text{ to } 8}=0$ and we are testing whether we can accept or reject it, thereby accepting an alternative hypothesis either H_A: $\beta_{1-8}>0$, or H_A: $\beta_{1-8}<0$, or H_A: $\beta_{1-8}\neq 0$ depending on whether carrying one or two tail test. From the t table, with N – K = 30 – 9 = 21 degrees of freedom, we can see that t ratios of RPB, DUM96 and QBt-1 are statistically significant (at 5% or lower significance level), RPL and RDIPH are relevant regressors at 10% significance level and there is, therefore, 10% uncertainty that these variable have in fact no impact on consumption of beef. T tests for RPP, RPC and TIME suggest that these variables are statistically insignificant. As these variables have t ratio less then $|1|$ they also push the R-bar squared down. To omit these variables from model in order to improve its explanatory power seemed to me theoretically unsatisfac tory so I decided to keep them. Taking into consideration all shortcomings and considering the other three models, the model (4) still seems to be the best one to choose.

Because "the size of a coefficient depends upon the units of measurement" [8] the interpretation of it can be a bit misleading. That is why we usually opt for calculating elasticity. This allows us to state what percentage change (estimated) in dependent variable is caused by percentage change in independent variable, cet.par. The results below are estimates of the elasticity of demand for beef with respect to RPB, RPP, R PC, and RDIPH for the initial regression:

[7] Statistics for Economics, Accounting and Business Studies, Mike Barrow, p.266
[8] Statistics for Economics, Accounting and Business Studies, Mike Barrow, p.265

$$\hat{\eta}_{rpb} = \left(\frac{\partial \hat{Q}B}{\partial RPB}\right) \times \left(\frac{\overline{RPB}}{\overline{QB}}\right) = -0.346 \times \left(\frac{363.251}{190.233}\right) = \underline{-0.661}$$

$$\hat{\eta}_{rpp} = \left(\frac{\partial \hat{Q}B}{\partial RPP}\right) \times \left(\frac{\overline{RPP}}{\overline{QB}}\right) = -0.417 \times \left(\frac{283.847}{190.233}\right) = \underline{-0.622}$$

$$\hat{\eta}_{rpc} = \left(\frac{\partial \hat{Q}B}{\partial RPC}\right) \times \left(\frac{\overline{RPC}}{\overline{QB}}\right) = -0.115 \times \left(\frac{186.661}{190.233}\right) = \underline{-0.113}$$

$$\hat{\eta}_{rdiph} = \left(\frac{\partial \hat{Q}B}{\partial RDIPH}\right) \times \left(\frac{\overline{RDIPH}}{\overline{QB}}\right) = -0.015 \times \left(\frac{6132.8}{190.233}\right) = \underline{-0.484}$$

The demand appears to be inelastic w.r.t. to each variable tested. The results suggest that in 1967-1996:

- a 10% rise in RPB would reduce the consumption of beef by 6.61%, cet. par.
- a 10% rise in RPP would decrease consumption of beef by 6.22%, cet. par.
- a 10% rise in RPC would reduce consumption of beef by 1.13%, cet. par.
- a 10% rise in RDIPH would reduce consumption of beef by 4.84%, cet.par.

By looking at t ratios of variables in model (1) we can raise questions about the reliability of results, mainly in case of RPC and RDIPH. In case of RPP it is also not very reliable because the t test could reveal the regressor is relevant to model at 10% significance level. This low reliability is a major explanation for divergence between our results and theoretical expectations. Not only would we expect positive signs in cases of RPP, RPC and RDIPH but also slightly higher value in absolute term for RPC. This once again shows how the demand function for beef is complicated and a lot of improvements could still be made.

Another way how to test model is through its ability to forecast correctly, "since this uses out-of-sample information"[9]. The plot of forecast for 1997-2000 with corresponding table is provided below.

Graph 2 Plot of Actual and Single Equation, Static Forecast

Table 2 Single Equation Static Forecasts

Year	Actual	Prediction	Error	Error in %
1997	110	125.081	-15.081	-13.710
1998	109	123.901	-14.901	-13.671
1999	110	120.835	-10.835	-9.850
2000	124	118.259	5.741	4.630
Mean	113.250	122.019	-8.769	-8.150

By inspecting *Graph 2* and *Table 2* it can be seen that model forecasted four-year period moderately well. The biggest error in over-prediction made the in the first year was offset by under-prediction in year 2000 to give overall error -8.15% compared to actual values. There is need to point out that for Microfit was relatively difficult to predict progress after year 1996 because of the exceptional BSE crisis in that year. Nevertheless, the dummy variable DUM96 helped significantly to spot this event and Microfit then correctly predicted higher consumption for years 1997 onwards.

In conclusion we can propose the improvements that could be made to obtain more reliable model with even higher explanatory power. Those improvements are basically represented in error term "ε" which takes into account possibility that there are still

[9] Statistics for Economics, Accounting and Business Studies, Mike Barrow, p.267

some omitted variables left outside the model. In our case we could implement more substitutes but mainly some form of complementary product, we could also add variable QB_{t-2} to take into consideration the consumption 2 years ago. The random changes in people's tastes cannot be captured by any variable so we never reach a model with 100% explanatory power. Term "ε" also stands for errors made in measurement. To enhance the model we could therefore double check the system of gathering input data, its recording and our calculations.

I certify that this work has **1493 words** (exclusive of appendices, footnotes, bibliography, tables and glossary).

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Textbooks:

- John Sloman (2003), *Economics*, Fifth edition, Prentice Hall
- Peter Kennedy (2003), A Guide to Econometrics, Fifth edition, Blackwell Publishing
- Christopher Dougherty (2002), Introduction to Econometrics, Second edition, Oxford University Press
- Mike Barrow (2001), Statistics for Economics, Accounting and Business Studies, Third edition, Pearson Education Limited

Lecture Handouts:

- Tony Flegg, Lecture Handout 27th February 2006: More on Modelling Demand

Appendix 1

```
Model (1)
                       Ordinary Least Squares Estimation
******************************************************************************
 Dependent variable is QB
 30 observations used for estimation from 1967 to 1996
******************************************************************************
 Regressor               Coeffi cient       Standard Error         T -Ratio[Prob]
 A                         609.2894            56.1734           10.8466[.000]
 RPB                        -.34643             .13144           -2.6357[.014]
 RPP                        -.41715             .2 3750          -1.7564[.092]
 RPC                        -.11469             .28425           -.40350[.690]
 RDIPH                     -.015144            .014155           -1.0698[.295]
 TIME                       -3.6683             2.6645           -1.3767[.181]
******************************************************************************
 R-Squared                      .90744   R -Bar-Squared                   .88815
 S.E. of Regression            12.9729   F -stat.    F(  5,  24)   47.0555[.000]
 Mean of Dependent Variable   190.2333   S.D. of Dependent Variable     38.7900
 Residual Sum of Squares        4039.1   Equation Log -likelihood     -116.1069
 Akaike Info. Criterion      -122.1069    Schwarz Bayesian Criterion   -126.3105
 DW-statistic                   1.1953
******************************************************************************


                               Diagnostic Tests
******************************************************************************
*    Test Statistics  *        LM Version        *         F Vers  ion
******************************************************************************
*                     *                          *
* A:Serial Correlation*CHSQ(   1)=   5.2347[.022]*F(   1,  23)=   4.8616[.038]
*                     *                          *
* B:Functional Form   *CHSQ(   1)=   6.7864[.009]*F(   1,  23)=   6.7239[.016]
*                     *                          *
* C:Normality         *C HSQ(   2)=   2.5300[.282]*       Not applicable
*                     *                          *
* D:Heteroscedasticity*CHSQ(   1)=  .018136[.893]*F(   1,  28)=  .016937[.897]
******************************************* *********************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

```
Model (2)
                       Ordinary Least Squares Estimation
******************************************************************************
 Dependent variable is QB
 30 observations used for estimation from 1967 to 1996
******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 A                        576.8631            60.7422             9.4969[.000]
 RPB                      -.41889             .14107             -2.9694[.007]
 RPP                      -.21793             .27986             -.77872[.444]
 RPC                     -.033300             .28716             -.11596[.909]
 RDIPH                   -.021779            .014860             -1.4656[.156]
 TIME                     -1.9411             2.9439             -.65934[.516]
 DUM96                   -24.0286            18.4855             -1.2999[.207]
******************************************************************************
 R-Squared                      .91377   R-Bar-Squared                   .89127
 S.E. of Regression            12.7904   F-stat.    F(  6,  23)  40.6213[.000]
 Mean of Dependent Variable   190.2333   S.D. of Dependent Variable     38.7900
 Residual Sum of Squares        3762.7   Equation Log-likelihood      -115.0435
 Akaike Info. Criterion      -122.0435    Schwarz Bayesian Criterion  -126.9477
 DW-statistic                   1.2033
******************************************************************************


                               Diagnostic Tests
****************************************************************************  ***
*    Test Statistics  *        LM Version        *         F Version
******************************************************************************
*                     *                          *
* A:Serial Correlation*CHSQ(   1)=   5.4407[.020]*F(   1,  22)=   4.8737[.038]
*                     *                          *
* B:Functional Form   *CHSQ(   1)=   4.6316[.031]*F(   1,  22)=   4.0166[.058]
*                     *                          *
* C:Normality         *CHSQ(   2)=   3.0502[.218]*       Not applicable
*                     *                          *
* D:Heteroscedasticity*CHSQ(   1)=  .032929[.856]*F(    1,  28)=  .030768[.862]
******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Model (3)

```
                       Ordinary Least Squares Estimation
****************************** ***********************************************
 Dependent variable is QB
 30 observations used for estimation from 1967 to 1996
************************************************* ***************************
 Regressor               Coefficient       Standard Error         T -Ratio[Prob]
 A                         389.1976           98.7007              3.9432[.001]
 RPB                        -.36312            .13171             -2.7570[.012]
 RPP                       -.095328            .26229             -.36345[.720]
 RPC                        .070688            .26737              .26438[.794]
 RDIPH                     -.017809            .013746            -1.2956[.209]
 TIME                       -.72223            2.7530             -.26234[.796]
 DUM96                     -24.2986            16.9651            -1.4323[.166]
 QB1                         .35342            .15339              2.3040[.031]
************************** **************************************************
 R-Squared                      .93053   R -Bar-Squared                  .90843
 S.E. of Regression            11.7382   F -stat.    F(  7,  22)  42.0990[.000]
 Mean of Dependent Variable   190.2333   S.D. of  Dependent Variable    38.7900
 Residual Sum of Squares        3031.3   Equation Log -likelihood     -111.8012
 Akaike Info. Criterion      -119.8012    Schwarz Bayesian Criterion  -125.4060
 DW-statistic                   1.6997
******************************************************************************


                               Diagnostic Tests
******************************************************************************
*    Test Statistics  *        LM Version        *         F Version
************************* ****************************************************
*                     *                          *
* A:Serial Correlation*CHSQ(   1)=   1.3473[.246]*F(   1,  21)=   .98745[.332]
*                     *                           *
* B:Functional Form   *CHSQ(   1)=   5.5773[.018]*F(   1,  21)=   4.7957[.040]
*                     *                          *
* C:Normality         *CHSQ(   2)=   1.2695[.530]*       Not ap plicable
*                     *                          *
* D:Heteroscedasticity*CHSQ(   1)=   2.6455[.104]*F(   1,  28)=   2.7079[.111]
******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regr ession of squared residuals on squared fitted values
```

Model (4)

```
                       Ordinary Least Squares Estimation
*******************************************************************************
 Dependent variable is QB
 30 observations used for estimation from 1967 to 1996
*******************************************************************************
 Regressor              Coefficient       Standard Error         T -Ratio[Prob]
 A                        308.0409          109.9132              2.8026[.011]
 RPB                      -.48924            .15277               -3.2025[.004]
 RPP                      -.057030           .25618               -.22262[.826]
 RPC                       .22030            .27806                .79230[.437]
 RDIPH                    -.027636           .014856              -1.8603[.077]
 TIME                      1.1953            2.9609                .40371[.691]
 DUM96                    -32.6325          17.3851               -1.8770[.074]
 QB1                       .43840            .15932               2.7517[.012]
 RPL                       .35445            .23430               1.5128[.145]
****************************************************** ********************
 R-Squared                     .93736   R -Bar-Squared                  .91350
 S.E. of Regression           11.4088   F -stat.    F(  8,  21)   39.2801[.000]
 Mean of Dependent Variable  190.2333   S.D. of Dependent Variable     38.79 00
 Residual Sum of Squares       2733.4   Equation Log -likelihood     -110.2496
 Akaike Info. Criterion     -119.2496    Schwarz Bayesian Criterion   -125.5550
 DW-statistic                  1.9742
**************** **************************************************************
```

```
                               Diag nostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version
****************************************************** ***********************
*                     *                          *
* A:Serial Correlation*CHSQ(   1)= .0070136[.933]*F(   1,  20)= .0046768[.946]
*                     *                          *
* B:Functional Form   *CHSQ(   1)=   3.4059[.065]*F(   1,  20)=   2.5614[.125]
*                     *                          *
* C:Normality         *CHSQ(   2)=   1.1051[.575]*       Not applicable
*                      *                          *
* D:Heteroscedasticity*CHSQ(   1)=   .91471[.339]*F(   1,  28)=   .88058[.356]
*******************************************************************************
   A:Lagrange multiplier test of  residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals o n squared fitted values
```

```
                       Single Equation Static Forecasts
******************************************************************************
 Based on  OLS regression of QB on:
 A               RPB              RPP              RPC              RDIPH
 TIME            DUM96            QB1              RPL
 30 observations used for estimation from 1967 to 1996
***************************** ************************************************
 Observation        Actual        Prediction        Error        S.D. of Error
  1997           110.0000        125.0811        -15.0811          18.1375
  1998           109.0000        123.9008        -14.9008          14.8397
  1999           110.0000        120.8353        -10.8353          16.4801
  2000           124.0000        118.2589          5.7411         17.9102
******************************************************************  ***********
```

```
            Summary statistics for single equation static forecasts
******************************************************************************
 Based on 4 observations from 1997 to 2000
 Mean Prediction Errors        -8.7690   Mean Sum Abs Pred Errors      11.6396
 Sum Squares Pred Errors     149.9598   Root Mean Sumsq Pred Errors   12.2458
 Predictive failure test    F(   4,  21)=   .68727[.609]
******************************************************************************
```

```
 Sample period    :1967 to 1996
 Variable(s)      :     QB        RPB       RPP       RPC       RDIPH      TIME
 Maximum          :  244.0000  458.9552  354.1045  231.9018    8607.0   31.000
 Minimum          :  101.0000  325.5876  239.2369   171.9259    4267.0    2.000
 Mean             :  190.2333  363.2512  283.8470  186.6608    6132.8   16.500
 Std. Deviation   :   38.7900   29.2564   33.1519   14.8209    1369.0    8.803
 Skewness         :   -.57768    1.3180    .66402    1.5150    .39170    -.000
 Kurtosis - 3     :   -.59869    1.9075   -.86778    1.6700   -1.1100   -1.202
 Coef of Variation:    .20391   .080540    .11679   .079400    .22322    .5335

 Sample period    :1967 to 1996
 Variable(s)      :   DUM96      QB1       RPL
 Maximum          :    1.0000  244.0000  331.3433
 Minimum          :      0.0 0  121.0000  259.0772
 Mean             :   .033333  194.5333  283.6681
 Std. Deviation   :    .18257   35.5739   15.6563
 Skewness         :    5.1995    -.51710    1.17 20
 Kurtosis - 3     :   25.0345    -.79842    1.7577
 Coef of Variation:    5.4772     .18287   .055192
```

Estimated Correlation Matrix of Variables

****

	QB	RPB	RPP	RPC	RDIPH	TIME
QB	1.0000	.32180	.52400	.30199	-.89998	-.85352
RPB	.32180	1.0000	.76901	.52433	-.60593	-.66833
RPP	.52400	.76901	1.0000	.78248	-.76345	-.85009
RPC	.30199	.52433	.78248	1.0000	-.49365	-.59813
RDIPH	-.89998	-.60593	-.76345	-.49365	1.0000	.98216
TIME	-.85352	-.66833	-.85009	-.59813	.98216	1.0000
DUM96	-.43448	-.24314	-.016637	.14859	.34135	.31109
QB1	.91928	.38868	.53644	.28084	-.88317	-.84189
RPL	-.18418	.56516	.40823	.28055	-.019704	-.12791

Estimated Correlation Matrix of Variables

****

	DUM96	QB1	RPL
QB	-.43448	.91928	-.18418
RPB	-.24314	.38868	.56516
RPP	-.016637	.53644	.40823
RPC	.14859	.28084	.28055
RDIPH	.34135	-.88317	-.019704
TIME	.31109	-.84189	-.12791
DUM96	1.0000	-.39041	.15084
QB1	-.39041	1.0000	-.20836
RPL	.15084	-.20836	1.0000

****************** ***

Appendix 2

Year	QB	RPB	RPL	RPP	RPC	RDIPH	QB1	TIME	DUM96
1966	230.0	382.0	288.0	325.0	246.0	4230.0		1.0	0.0
1967	244.0	374.0	278.0	340.0	232.0	4270.0	230.0	2.0	0.0
1968	220.0	399.0	290.0	339.0	221.0	4330.0	244.0	3.0	0.0
1969	218.0	399.0	293.0	331.0	211.0	4340.0	220.0	4.0	0.0
1970	221.0	389.0	284.0	333.0	204.0	4490.0	218.0	5.0	0.0
1971	226.0	393.0	279.0	314.0	202.0	4520.0	221.0	6.0	0.0
1972	196.0	406.0	295.0	321.0	181.0	4890.0	226.0	7.0	0.0
1973	179.0	459.0	331.0	354.0	200.0	5190.0	196.0	8.0	0.0
1974	208.0	403.0	320.0	316.0	192.0	5130.0	179.0	9.0	0.0
1975	238.0	349.0	277.0	315.0	185.0	5170.0	208.0	10.0	0.0
1976	217.0	348.0	272.0	294.0	175.0	5150.0	238.0	11.0	0.0
1977	233.0	327.0	270.0	264.0	175.0	5050.0	217.0	12.0	0.0
1978	234.0	350.0	291.0	290.0	178.0	5430.0	233.0	13.0	0.0
1979	235.0	352.0	278.0	273.0	180.0	5730.0	234.0	14.0	0.0
1980	231.0	349.0	271.0	266.0	183.0	5810.0	235.0	15.0	0.0
1981	198.0	358.0	265.0	263.0	172.0	5780.0	231.0	16.0	0.0
1982	201.0	365.0	280.0	255.0	173.0	5770.0	198.0	17.0	0.0
1983	187.0	370.0	262.0	266.0	179.0	5910.0	201.0	18.0	0.0
1984	178.0	358.0	272.0	272.0	179.0	6110.0	187.0	19.0	0.0
1985	185.0	356.0	275.0	266.0	179.0	6290.0	178.0	20.0	0.0
1986	187.0	352.0	274.0	261.0	184.0	6550.0	185.0	21.0	0.0
1987	192.0	341.0	286.0	263.0	178.0	6770.0	187.0	22.0	0.0
1988	180.0	359.0	287.0	255.0	179.0	7100.0	192.0	23.0	0.0
1989	171.0	376.0	279.0	270.0	182.0	7380.0	180.0	24.0	0.0
1990	149.0	344.0	277.0	276.0	189.0	7630.0	171.0	25.0	0.0
1991	152.0	339.0	259.0	257.0	182.0	7720.0	149.0	26.0	0.0
1992	141.0	329.0	280.0	257.0	172.0	7980.0	152.0	27.0	0.0
1993	133.0	346.0	298.0	244.0	177.0	8190.0	141.0	28.0	0.0
1994	131.0	343.0	302.0	239.0	182.0	8270.0	133.0	29.0	0.0
1995	121.0	338.0	288.0	243.0	173.0	8450.0	131.0	30.0	0.0
1996	101.0	326.0	296.0	281.0	198.0	8610.0	121.0	31.0	1.0
1997	110.0	333.0	318.0	267.0	210.0	8900.0	101.0	32.0	0.0
1998	109.0	323.0	284.0	238.0	201.0	8880.0	110.0	33.0	0.0
1999	110.0	324.0	297.0	230.0	208.0	9230.0	109.0	34.0	0.0
2000	124.0	320.0	311.0	253.0	211.0	9600.0	110.0	35.0	0.0