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MODELING HOME EQUITY CONVERSION MORTGAGES

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ABSTRACT

Many seniors who own houses in the United States have most of their wealth in their houses. Some may not have sufficient wealth to pay for (1) medical bills resulting from a sudden medical problem, (2) major repairs to their houses, and/or (3) everyday expenses for food, clothing, etc. Home Equity Conversion Mortgages (HECMs) are designed to allow seniors to borrow money (e.g., a level-payment monthly annuity) using the equity in their houses as collateral, without being forced to move out of their homes. Private companies (e.g., Providential Home Income Plan and Capital Holding Corporation) as well as the Federal Housing Administration (FHA) currently offer HECMs. We describe here a stochastic simulation approach used to estimate the amount of a level-payment annuity payable as long as the senior is alive and living in his/her house.

1. Introduction

Many seniors who own their own homes in the United States have most of their wealth in their houses. Some may not otherwise have sufficient wealth to pay for (1) medical bills resulting from a sudden medical problem, (2) major repairs to their houses, and/or (3) everyday expenses for food, clothing, etc. Home Equity Conversion Mortgages (HECMs) are designed to allow seniors to borrow money using the equity in their homes as collateral, without being forced to move out of their homes. The amounts borrowed accumulate with interest until the mortgage's due date at which point the lender is repaid his entire debt.

There are three principal types of HECMs: term, split-term, and tenure. In a term HECM, equal monthly payments are made to the senior/homeowner for a certain number of months, e.g., 180 months or fifteen years. At the end of the term, the loan is due and payable. Term HECMs are not popular with seniors who fear they will not be able to repay the loan at the end of the term and will then be forced out of their homes.

In a split-term HECM, equal monthly payments are made for a certain number of months but the loan need not be repaid until the senior dies, moves out, or sells his/her house. Finally, in a tenure HECM equal monthly payments are made and the loan need not be repaid as long as the senior is alive and living in his/her house.

The purpose of this work is to investigate the actuarial aspects of HECMs. In particular, we attempt to estimate the amount of the level-payment (annuity) of a tenure HECM. We assume an insurance premium structure consisting of two components. The first, payable at origination, is equal to 2 percent of the appraised value of the property. The second is an annual insurance fee equal to 0.5 percent of the actual outstanding balance of the loan and is payable monthly. We also assume that the insurer/mortgagee has a share of the future appreciation, if any, of the house.

The statistical model employed here is based on Herzog and Rubin[1983]. Our HECM model attempts to approximate likely future experience and is flexible in the sense that it can incorporate a wide range of assumptions. Another important feature of our model is that it incorporates the variation associated with the key parameters of the model. Since these parameter values are themselves statistical estimates, such a model more accurately reflects the total variation of the process of interest.

Our results, summarized in Table 4, show that viable HECM programs can be constructed using either a 50/50 shared appreciation scheme (i.e., where the mortgagor and insurer/mortgagee share future nominal appreciation equally) or one in which the insurer/mortgagee gets 100 percent of nominal appreciation. Of course, the monthly payments are slightly higher in the 100 percent case.

Appendix 1 consists of two examples which show how a HECM works in practice and helps to clarify some of the terms mentioned above.

2. Assumptions

In this section, we discuss the assumptions of our model.

2.1 Appreciation

The annual rate of nominal appreciation of individual houses is a key element of the HECM model. Estimates of the annual rate of nominal appreciation are necessarily imprecise since (1) the rate of appreciation may vary widely from year-to-year and from neighborhood to neighborhood and (2) the expense of annual appraisals on individual houses makes the attainment of a reliable nationally representative database of U.S. house values impractical.

Our approach to estimating the nominal appreciation of HECM houses is to construct a two-stage stochastic simulation model.[1] In the first stage, we use annual national appreciation data compiled by the National Association of Realtors (NAR)[1989] to simulate the posterior distribution of national appreciation rates. We then use the results of the first-stage model together with some metropolitan area NAR data to simulate the posterior distribution of appreciation rates of individual HECM houses.

As shown in the last column of Table 1, the NAR's mean annual rate of increase of the median sales price of an existing home between December 1981, and December 1988, was 4.26%. The corresponding sample variance was 0.000256. The sample autocovariance coefficients of these appreciation rates at lags of one, two, and three years are 0.000110, 0.000029, and 0.00000884, respectively.

1 Pseudo-Random Number Generator.
The uniform pseudo-random numbers used in this analysis are all generated using the APL primitive function roll (denoted by "?") on an IBM 3090 mainframe computer. This function is a multiplicative conguential pseudo-random number generator with a multiplier of $16807 = 7^5$, a modulus of 2^{31}-1, and an initial seed (or starting value) of 16807. This generator is selected because it is the least expensive to use on the available mainframe's APL system even though multiplicative congruential generators have some deficiencies as Marsaglia[1968] has pointed out. The pseudo-random normal deviates were generated using the polar method as described, for example, in Freiden and Herzog[1979] who demonstrate that this is the preferred procedure for generating such numbers in APL.

We assume that the first-stage model has a multivariate normal distribution with mean 4.26% and variance-covariance matrix equal to .0001 times:

$$\begin{bmatrix} 2.56 & 1.10 & 0.29 & 0 & \cdots & \cdots & \cdots & 0 \\ 1.10 & 2.56 & 1.10 & 0.29 & \ddots & & & \vdots \\ 0.29 & 1.10 & 2.56 & 1.10 & \ddots & \ddots & & \vdots \\ 0 & \ddots & \ddots & \ddots & \ddots & \ddots & \ddots & 0 \\ \vdots & & \ddots & 1.10 & 2.56 & 1.10 & 0.29 \\ \vdots & & & 0.29 & 1.10 & 2.56 & 1.10 \\ 0 & \cdots & \cdots & 0 & 0.29 & 1.10 & 2.56 \end{bmatrix}$$

Thus, we assume that the average rate of appreciation over the entire U.S. in year $n + 2$ is influenced by the rates of appreciation in years n and $n + 1$.

The second-stage model is used to predict the appreciation rates of individual house values. For each year, we use a separate univariate normal distribution whose mean is the corresponding result of the first stage model and whose standard deviation is 0.08. The value of 0.08 is chosen as a rough measure of the dispersion of the distribution of annual appreciation rates from the first quarter of 1988 to the first quarter of 1989 in the 84 large metropolitan areas of the United States considered by Downs[1989]. In particular, we note from Appendix 2 that based on a mean annual appreciation rate of 5.21% and a standard deviation of 8 percent, we observe one metropolitan area, namely Fort Worth, whose appreciation rate is more than 2 standard deviations below the mean and five metropolitan areas in California -- San Francisco, Orange County, Los Angeles, San Diego, and Riverside -- whose appreciation rates are more than two standard deviations above the mean.

The procedure used to generate the random normal deviates required for both stages of the model is described in Section 2.2 of Herzog[1984].

In addition to 4.26%, we also run the model with annual average appreciation rates of 3%, 2%, and 0%. This is because the appreciation rates of HECM houses may be substantially below average. As Goldstein[1984] says:

> **"Elderly people tend to live in the oldest housing stock. About 6 of every 10 young-old householders lived in housing built before 1950, a slightly higher proportion than younger householders. This proportion increased with the age of the householders—66 to 71 percent of middle-old householders and 73 to 82 percent of very old households lived in pre-1950 housing stock. While this housing, which is over 30 years old, is not necessarily in poor condition, it is likely to need more maintenance than newer structures. The people most often found in this older housing, the oldest old, may have the most difficulty keeping it in good repair, especially if they are its owners."**

Thus, because the elderly tend to live in the oldest housing stock, have difficulty keeping their property in good repair, and are unlikely to make home improvements, their property is not likely to appreciate as fast as other property.

2.2 Mortality Rates

The basic mortality rates are taken from Wade[1989]. Following May and Szymanoski[1989], we assume that all of the mortgagors are single females. This may not be a sufficiently conservative assumption if many married couples or other groups obtain HECMs jointly. Unfortunately, the Social Security Administration is not currently able to provide us with the necessary projected joint mortality rates for married couples. Moreover, our model does not incorporate the likely adverse selection of healthier seniors choosing a HECM. Consequently, we recommend that those using this model to price a HECM product make appropriate adjustments for these two factors.

As with the appreciation component, we develop a two-stage stochastic simulation model to predict future mortality experience of HECM mortgagors. In the first stage, we simulate the death rates q_{65}, q_{70}, ..., q_{105} using a separate univariate normal model for each death rate. The means of these models are taken from Wade[1989] (see Table 2). In particular, we use the value of q_{65+x} projected for calendar year $1990 + x$, for $x = 0, 5, ..., 40$. We set q_{110} equal to one - - i.e., we assume that no one survives to age 111.

The standard errors are estimated as follows. We first use the method of least squares to fit a separate linear equation to each of the four sets of 26 values of q_{65+x}, for $x = 0, 5, 10, 15$. The 26 values of the q's are taken from the 1961-1986 U.S. Life Tables for Female Lives, constructed by the National Center for Health Statistcs (see Table 3). The standard error of the estimate is used as the estimated standard error of each of these four sets of q's. The remaining estimated standard errors are obtained by fitting a linear equation to the standard errors of the estimates of q_{70}, q_{75}, and q_{80}. The resulting equation is:

$$\text{standard error of } q_{60+5x} = .000686x - .00074$$

for $x = 5, 6, 7, 8, 9$.

After the first-stage simulation model is run, we obtain the intermediate mortality rates by using a geometric interpolation procedure described on page 272 of Waldman and Gordon[1988]. To illustrate this method, we calculate

$$q_{70+x} = (q_{70})(q_{75}/q_{70})^{x/5} \qquad \text{for} \quad x = 1, 2, 3, 4.$$

The second-stage model is a binomial model which simulates the experience of each of the individual insureds. The mortality rates used here are those resulting from the first stage of the model and the interpolation scheme described above. The procedure used to select pseudo-random numbers from a binomial distribution is described in Section 2.3.1 of Herzog[1984].

Finally, we wonder how the value of the property will be affected if probate problems increase the time it takes the insurer/mortgagee to acquire legal title to the property.

2.3 Move-Out Rates

Some mortgagors may move out of their homes and repay their HECM loan because they are in poor health and need to move to a hospital, nursing home, or the home of a friend or relative. Others may move simply because they desire to live in another place. Because their monthly HECM payments terminate in all of these instances, it is important for us to accurately predict the rate and time at which such moves take place for the population of insureds. Unfortunately, there is little or no useful data currently available to construct such estimates. One possible source is Jacobs[1988] who has examined some data collected by the U.S. Bureau of the Census. The principal problem with this analysis is that it deals with the entire population. For example, Jacobs[1988] estimates the "move-out" rate of 85-year olds to be about 30 percent of their mortality rate. Can this rate be applied to individuals who have HECMs? Can it be applied to the first six months of the term of a HECM? Since answers to these questions are speculative, it is not at all clear what estimates should be used. May and Szymanoski[1989] use a rate of 30 percent at all ages. We have employed this assumption as well as an alternate assumption of zero. While we know zero is too low, it nevertheless does give a measure of the sensitivity of our results to changes in the value of this parameter.

2.4 Origination Fees and Other Closing Costs

We assume that at the time the HECM is originated the mortgagor pays closing costs equal to 1.5 percent of the appraised value of the property. This is intended to cover such costs as the origination fee charged by the lender, the cost of the appraisal of the property, and legal fees.

2.5 Transaction Costs

We include estimated transaction costs incurred in selling the house after the senior dies or moves out. Since the real estate sales commission is normally 6 or 7 percent and there are frequently other costs borne by the seller, we assume seller transaction costs of 8 percent of the sales price of the house. If the insurer/mortgagee has to take possession of the property and carry out the preservation normally done for a PD (property disposition) property, the transaction costs may be larger than 8 percent. Foster and van Order[1984] used transaction costs of 10% of the sales price of the house in their study of defaults on FHA-insured mortgages. We also wonder if the insurer/mortgagee will be notified promptly after seniors die or move out of their homes.

2.6 Salaries and Administrative Expenses

We include a component for staff salaries and administrative expenses incurred in running a HECM operation. We set this cost equal to 1 percent of the initial appraised value of the property insured. This rate is comparable to that employed in the principal FHA single-family program.

2.7 Interest Rates

We consider three pairs of assumptions for the contract interest rate on the annuity and the discount rate:

contract interest rate	discount rate
8.5%	7.0%
10.0%	8.5%
11.5%	10.0%

2.8 House Price

We assume that the HECM is based on an appraised house value of $100,000. This value is selected for mathematical convenience. If the appraised house value is less than $100,000, then the amount of the monthly payment should be reduced proportionally. The NAR data shown in Appendix 2 for the entire United States give a median home sales price of $91,600 for the first quarter of calendar year 1989. Hence, even in 1990 a substantial portion of the seniors in the U.S. may have less than $100,000 of equity in their homes. Consequently, their monthly payments would be less than those shown in Table 4 below.

3. Results

We have run each of the first-stage models 10 times and simulated 100 individual HECMs for each such outcome. Thus, we have simulated a total of 1,000 individual HECMs. The mean of the 1,000 simulations is shown in Table 4 and the corresponding standard error in Table 5. These results are sensitive to changes in mean annual appreciation rates, mortality rates, interest rates, and move-out factors. The choice of an appropriate set of assumptions is of course subjective. The insurer/mortgagee naturally must be conservative. Using a move-out factor of 1.0 (to compensate for the high mortality rates resulting from the use of female lives selected from the general population), an annual average nominal appreciation rate of 2%, a contract interest rate of 11.5%, and a discount rate of 10.0%, we obtain a monthly payment of around $220 with a 50/50 shared appreciation HECM and $245 with all of the potential appreciation going to the insurer/mortgagee. Hence, HECM instruments may be attractive to some senior homeowners. On the other hand, if the insurer decides to decrease the projected mortality rates sharply, increase the standard deviation of the second stage appreciation model (say from 8% to 18 or 20%), and/or eliminate the shared appreciation feature, then the monthly HECM payment may be so low that no seniors will be interested in obtaining one.

Appendix 1

EXAMPLE 1

Ms. Jones is 65 years old and owns her home at 123 Elm Street, which is worth $100,000. She has no mortgage on her house. Ms. Jones decides she needs additional monthly income to pay her property taxes and her utility bills. So, she obtains a HECM from the XYZ Bank which, in turn, obtains insurance on this mortgage through the ABC Insurance Company.

Ms. Jones agrees to give the XYZ Bank all future appreciation, if any, on her house. The bank agrees to pay Ms. Jones $313 per month for as long as she is alive and residing at 123 Elm St. The bank charges Ms. Jones interest at the rate of 10% per annum compounded monthly. The ABC Insurance Company assumes house values will appreciate at an annual rate of 3% and that 30% of the people will move out before they die (more specifically, the move-out factor is assumed to be 1.3). Finally, the insurance company assumes its cost of funds (discount rate) is 8.5% compounded semi-annually. Using Table 4, the XYZ Bank verifies Ms. Jones' monthly payment to be $313.

Ms. Jones closes on her mortgage on February 1, 1990. She borrows $3,500 at closing to pay (1) a $1,000 origination fee to the XYZ Bank, (2) a $2,000 insurance premium to the ABC Insurance Company, (3) and $500 for other closing costs, including appraisal and legal fees. (The $1,000 reimburses the bank for the cost of initiating this mortgage.) Ms. Jones begins receiving her monthly payments on February 1, 1990. She is also charged monthly insurance premiums at the annual rate of 0.5% of her outstanding loan balance.

Ten years later, at age 75, Ms. Jones suffers a stroke and moves permanently to a nursing home. Her house is sold for $134,935 which, fortunately, is more than the $74,972 outstanding balance on her loan. Ms. Jones receives $25,028 (i.e., $100,000 - $74,972) and the ABC Insurance Company is paid the outstanding balance of the loan plus the $34,935 (nominal) appreciation on the house. (If the appreciation had been shared 50/50, Ms. Jones and the XYZ Bank would have each received half of the $34,935.)

EXAMPLE 2

Modify Example 1 by assuming that Ms. Jones has her stroke at age 85 instead of 75. The outstanding loan balance at the end of 20 years is $279,253 and the house is sold for $182,076. In this case, the sales price will not be enough to pay off the loan and so the ABC Insurance Company will have to pay the XYZ Bank the difference of $97,177 (i.e., $279,253 - $182,076). There is no money paid to Ms. Jones.

Appendix 2

NATIONAL ASSOCIATION OF REALTORS' METRO AREA HOME SALES PRICE DATA, QI 1989

Analyzed by Anthony Downs METRO.AREA (MSA)	MEDIAN HOME PRICE 1989 QI	ANN.PCT PRICE CHANGE 1988–89 QI	—QUARTERLY PCT. CHANGES IN MEDIAN HOME PRICES— 88 QI- 88 QII				TOTAL MSA POPUL AS OF 7/1/1987
			88 QI- 88 QII	88 QII- 88 QIII	88 QIII- 88 QIV	88 QIV- 89 QI	
TOP FOUR AREAS							
1 San Francisco, CA	243.9	31.77	12.80	4.84	6.17	4.95	1590000
2 Orange County, CA	237.9	30.21	9.47	8.70	4.14	5.08	2219100
3 Honolulu, HI	236.0	18.95	0.15	13.74	-0.44	4.89	830600
4 Los Angeles, CA	201.0	26.34	9.93	8.18	1.00	5.18	8504500
Averages or totals	229.7	26.82	8.09	8.86	2.72	5.02	13144200
VERY HIGH-PRICED NEXT EIGHT AREAS							
5 Nassau, NY	181.7	-2.83	3.74	-0.72	-6.65	1.06	2631000
6 New York, NY	181.7	-2.83	3.74	-0.72	-6.65	1.06	8528800
7 Boston, MA	178.5	0.90	3.39	0.49	-2.45	-0.45	2841700
8 New Haven, CT	166.7	-1.30	0.00	----	-7.67	4.06	519000
9 Hartford, CT	165.5	-0.54	1.56	-0.12	-2.25	0.30	747600
10 San Diego, CA	163.9	21.95	6.03	6.74	3.35	4.26	2285900
11 Washington, DC	143.7	8.53	-0.91	3.51	-4.20	10.45	3646000
12 Worcester, MA	139.1	-5.89	-1.22	----	-6.47	-2.80	410200
Averages or totals	165.1	2.25	2.04	1.15	-4.12	2.24	21610200
HIGH HOUSING PRICE AREAS							
13 Providence, RI	128.8	4.46	5.76	1.15	0.83	-3.16	642700
14 Springfield, MA	124.5	9.98	-6.54	----	-4.47	2.30	229000
15 Riverside, CA	116.1	21.57	9.53	4.78	3.28	2.56	2119000
16 Albany, NY	102.1	17.36	4.71	1.32	8.45	2.00	846400
17 Raleigh-Durham, NC	102.0	16.31	13.80	----	-2.40	4.51	665400
18 Philadelphia, PA	100.4	2.76	4.30	4.51	-2.25	-3.55	4866500
19 Sacramento, CA	100.3	13.72	4.65	----	-2.79	2.98	1336500
20 Seattle, WA	99.7	13.04	6.12	-5.02	3.37	8.49	1795900
21 Chicago, IL	99.3	7.00	7.00	1.51	-2.38	0.91	6199000
22 West Palm Bch. FL	94.4	3.17	3.61	13.29	-5.03	-7.45	790100
23 Baltimore, MD	92.2	10.29	4.43	5.73	-2.93	2.90	2302900
Averages or totals	105.43	10.88	5.22	2.48	-0.57	1.14	21793400

N.A.R. METRO AREA HOME PRICE DATA

METRO.AREA (MSA)	MEDIAN HOME PRICE 1989 QI	ANN.PCT PRICE CHANGE 1988–89 QI	QUARTERLY PCT. CHANGES IN MEDIAN HOME PRICES 88 QI–88 QII	88 QII–88 QIII	88 QIII–88 QIV	88 QIV–89 QI	TOTAL MSA POPUL. AS OF 7/1/1987
MODERATE HOUSING PRICE AREAS							
24 Dallas, TX	88.4	2.67	−0.35	0.12	−1.63	4.62	2456000
25 Minneapolis, MN	85.9	1.78	−0.12	2.02	1.40	−1.49	2335600
26 Charlotte, NC	85.2	——	——	——	——	−0.81	1091000
27 Rochester, NY	84.2	15.03	0.68	6.24	−2.55	10.35	979100
28 Miami, FL	82.6	5.90	7.05	−1.08	1.69	−1.67	1791500
29 Albuquerque, NM	82.0	2.89	2.38	2.21	−9.11	8.18	486200
30 Fort Lauderdale, FL	81.9	4.20	0.76	6.94	−3.90	0.61	1162600
31 Saint Louis, MO	81.4	9.85	7.29	2.01	−6.66	7.53	2458100
32 Denver, CO	80.8	−3.46	−0.36	−2.76	−1.73	1.38	1644500
33 Las Vegas, NV	80.5	6.34	2.91	3.59	−13.01	14.67	599900
34 Atlanta, GA	80.3	——	——	——	−0.74	−0.25	2656800
35 Nashville, TN	79.6	2.58	0.90	−0.26	−2.05	4.05	956200
36 Orlando, FL	79.1	0.51	−1.27	4.63	−3.94	1.28	934700
37 Phoenix, AZ	78.5	−0.63	0.13	4.05	−3.28	−1.38	1959600
38 Birmingham, AL	77.3	5.75	4.65	1.05	−3.10	3.20	916900
39 Memphis, TN	77.0	−0.65	−0.90	−0.26	−2.74	3.36	971900
40 Syracuse, NY	76.9	12.92	9.99	0.67	0.66	1.32	647000
41 Fort Worth, TX	75.3	−10.89	−2.25	−4.84	−0.89	−3.34	1268900
42 Lexington, KY	74.9	7.46	4.30	——	−0.26	−0.66	341500
43 Madison, WI	74.7	10.34	6.06	——	−4.72	5.66	347400
44 Milwaukee, WI	74.5	2.62	3.72	0.40	−3.31	1.92	1389100
45 Columbus, OH	73.9	11.63	10.88	1.50	0.13	−0.94	1320100
46 Kansas City, MO	73.8	4.09	1.41	−2.78	−0.86	6.49	1546400
47 Cincinnati, OH	73.2	9.75	4.35	3.16	−2.23	4.27	1438300
48 Charleston, SC	72.4	−0.28	1.24	1.22	−4.17	1.54	502100
49 Columbia, SC	71.9	5.27	3.37	——	−2.83	4.66	451400
50 Detroit, MI	71.9	0.56	1.12	5.67	−3.93	−2.04	4361600
51 Tampa, FL	71.7	19.10	8.80	3.66	−2.50	8.31	1965100
52 New Orleans, LA	71.2	−2.47	0.27	2.19	−5.21	0.42	1321000
53 Knoxville, TN	69.8	5.28	−1.06	5.34	−3.18	4.33	594000
54 Cleveland, OH	69.4	4.36	5.11	5.11	−0.72	0.14	1851400
55 Buffalo, NY	68.7	7.18	1.09	2.78	0.00	3.15	958300
56 Indianapolis, IN	68.0	10.03	7.93	1.20	−1.33	2.10	1228600
57 Portland, OR	67.1	6.68	3.18	−0.15	0.00	3.55	1167800
58 Salt Lake, UT	66.5	1.84	1.68	5.42	−3.29	−1.77	1054500
59 Montgomery, AL	65.9	5.61	5.13	——	−2.60	3.62	297400
60 Jacksonville, FL	65.9	−4.35	−2.18	1.04	1.04	−2.95	878200
61 Chattanooga, TN	65.6	7.19	3.27	——	1.09	1.08	431500
Averages or totals	75.5	4.39	2.66	1.58	−2.38	2.49	48762200

N.A.R. METRO AREA HOME PRICE DATA

METRO.AREA (MSA)	MEDIAN HOME PRICE 1989 QI	ANN.PCT PRICE CHANGE 1988-89 QI	—QUARTERLY PCT. CHANGES IN MEDIAN HOME PRICES— 88 QI- 88 QII	88 QII- 88 QIII	88 QIII- 88 QIV	88 QIV- 89 QI	TOTAL MSA POPUL AS OF 7/1/1987
LOW HOUSING PRICE AREAS							
62 Dayton, OH	64.4	4.21	2.59	——	-0.31	1.26	938800
63 Little Rock, AR	63.4	0.63	0.16	——	-2.74	-0.63	511500
64 Corpus Christi, TX	63.2	0.00	2.53	——	5.22	-4.96	360300
65 Houston, TX	62.9	4.49	5.48	3.15	-13.28	10.74	3228100
66 Pittsburgh, PA	62.4	2.46	2.13	6.59	-5.28	-0.64	2105400
67 Greenville, SC	61.9	-3.43	1.25	——	-6.11	-4.03	611900
68 Baton Rouge, LA	61.1	-7.00	-1.83	——	1.09	-5.71	538300
69 Omaha, NE	60.9	4.46	0.69	2.73	-0.66	1.67	616400
70 San Antonio, TX	60.8	-4.10	2.84	4.60	-8.94	-2.09	1306700
71 Tulsa, OK	60.5	-4.72	2.36	0.77	-0.31	-7.35	733000
72 Wichita, KN	60.4	4.86	4.69	——	-3.87	1.34	474700
73 Grand Rapids, MI	59.6	7.58	5.23	1.20	0.34	0.68	657000
74 Daytona Beach, FL	59.5	0.34	6.75	——	2.23	-7.18	331900
75 Lansing, MI	57.9	8.43	8.24	——	-1.40	3.02	427800
76 Toledo, OH	57.7	2.12	5.66	0.3	-5.84	2.30	611000
77 Des Moines, IA	57.3	5.14	6.79	-5.5	-0.36	4.56	385100
78 El Paso, TX	57.2	-1.04	4.67	2.5	-5.16	-2.72	572800
79 Louisville, KY	56.7	8.62	3.64	3.5	-1.61	2.90	966500
80 Akron, OH	56.0	-1.93	5.25	——	-6.71	-4.11	647000
81 Oklahoma City, OK	52.3	-7.43	0.71	1.8	-7.60	-2.24	975000
82 Mobile, AL	50.9	0.59	-1.78	——	-0.53	-8.78	483000
83 Spokane, WA	50.2	0.60	6.01	——	-1.18	-0.20	355300
84 Peoria, IL	42.0	1.45	11.11	——	-3.28	-5.19	338500
Averages or totals	58.2	1.14	3.70	0.94	-2.88	-1.19	18176000
AVERAGES OR TOTAL All 84 metro areas	90.6	5.21	3.48	1.83	-2.20	1.40	123486000
UNITED STATES	91.6	3.40	——	——	——	——	243400000

Table 1

ANNUAL APPRECIATION RATES
1981-1988

Year	Existing Homes Median Sales Price	Annual Appreciation Rate
1981	$66,600	--
1982	67,800	1.80%
1983	70,300	3.69
1984	72,400	2.99
1985	75,500	4.28
1986	80,300	6.36
1987	85,600	6.60
1988	89,100	4.09
Mean		4.26%

Source: National Association of Realtors

Table 2

MORTALITY RATE BY YEAR FOR ANNUITANTS AGED 65 IN 1990

q_{65}^{1990}	1.3653%
q_{70}^{1995}	2.0428%
q_{75}^{2000}	2.8602%
q_{80}^{2005}	4.4065%
q_{85}^{2010}	6.9947%
q_{90}^{2015}	11.5756%
q_{95}^{2020}	17.8137%
q_{100}^{2025}	23.2054%
q_{105}^{2030}	28.7804%

Source: U.S. Dept. of Health and Human Services, Social Security Administration

Table 3

U.S. FEMALE MORALITY RATES BY AGE
AND CALENDAR YEAR

Calendar Year	AGE 65	70	75	80
1961	1.83%	2.84%	4.64%	7.65%
1962	1.84	2.84	4.69	7.73
1963	1.85	2.84	4.71	7.78
1964	1.80	2.73	4.52	7.46
1965	1.79	2.69	4.50	7.44
1966	1.78	2.73	4.52	7.41
1967	1.73	2.66	4.37	7.12
1968	1.78	2.71	4.46	7.29
1969	1.72	2.66	4.32	7.04
1970	1.69	2.64	4.33	6.99
1971	1.62	2.57	4.20	6.75
1972	1.62	2.62	4.24	6.71
1973	1.57	2.53	4.16	6.62
1974	1.51	2.47	3.95	6.30
1975	1.44	2.36	3.77	5.95
1976	1.43	2.30	3.68	5.86
1977	1.42	2.24	3.55	5.65
1978	1.42	2.22	3.48	5.62
1979	1.39	2.15	3.37	5.45
1980	1.44	2.21	3.46	5.61
1981	1.43	2.17	3.39	5.62
1982	1.42	2.13	3.30	5.28
1983	1.40	2.15	3.34	5.39
1984	1.40	2.15	3.33	5.38
1985	1.40	2.15	3.35	5.41
1986	1.40	2.16	3.33	5.34

Source: U.S. Dept. of Health and Human Services,
National Center for Health Statistics

Table 4

Monthly Annuity Payments
Based on a $100,000 House and
an Annuitant Age 65 at Purchase

Contract Interest Rate		11.5%	10.0%	8.5%
Discount Rate		10.0	8.5	7.0
Move-Out Factor = 1				
Appreciation Rate	% Apprec. Shared			
4.258%	100%	$335	$379	$433
	50	269	298	334
3.0	100	282	314	352
	50	240	264	292
2.0	100	247	272	302
	50	221	240	264
0	100	193	208	226
	50	185	199	215

Contract Interest Rate		11.5%	10.0%	8.5%
Discount Rate		10.0	8.5	7.0
Move-Out Factor = 1.3				
Appreciation Rate	% Apprec. Shared			
4.258%	100%	$395	$439	$493
	50	321	352	388
3.0	100	337	370	410
	50	290	315	344
2.0	100	299	325	356
	50	269	289	314
0	100	238	254	273
	50	229	243	261

Table 5

Standard Errors for Monthly Annuity Payments
Based on a $100,000 House and
an Annuitant Age 65 at Purchase

Contract Interest Rate		11.5%	10.0%	8.5%
Discount Rate		10.0	8.5	7.0
Move-Out Factor = 1				
Appreciation Rate	% Apprec. Shared			
4.258%	100%	$27.54	$30.96	$36.42
	50	22.99	22.30	22.82
3.0	100	24.19	26.12	29.18
	50	22.64	21.65	21.28
2.0	100	23.07	23.15	24.99
	50	22.25	21.05	20.69
0	100	20.78	19.90	20.45
	50	20.60	20.07	19.73

Contract Interest Rate		11.5%	10.0%	8.5%
Discount Rate		10.0	8.5	7.0
Move-Out Factor = 1.3				
Appreciation Rate	% Apprec. Shared			
4.258%	100%	$48.60	$51.53	$55.16
	50	42.01	42.68	43.41
3.0	100	44.61	46.63	48.88
	50	40.62	40.75	41.73
2.0	100	41.32	42.85	44.64
	50	39.03	39.70	39.83
0	100	36.62	37.09	37.79
	50	36.00	36.09	36.45

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