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**LIBRARY REFERENCE USPS-LR-J-126  
STEP BY STEP CALCULATIONS OF VOLUME PROJECTIONS**

Category Two Library Reference  
(Tolley, USPS-T-7)

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**LIBRARY REFERENCE USPS-LR-J-126:  
STEP BY STEP CALCULATIONS OF VOLUME PROJECTIONS**

**I. Introduction**

**A. Overview**

This category 2 library reference provides a step-by-step guide to the calculation of the before-rates volume forecasts of single-piece First-Class letters and presort, nonautomated First-Class cards as examples of the methodology used to make the volume forecasts as presented in USPS-T-7. The methodology for projecting mail volumes was developed in the Technical Appendix.

The forecasted volume of a mail category is equal to its base volume multiplied by a series of projection factors which measure the impact of different variables on mail volume. Within the forecast spreadsheets, which are filed in Library Reference LR-J-125, forecasts are made for fourteen Postal quarters, beginning with 2001Q4 and ending with 2005Q1. These quarterly volume forecasts are then combined (along with historical volume data for the first three quarters of 2001) into Government Fiscal Year (GFY) forecasts for 2001, 2002, 2003, and 2004. The conversion of the quarterly volume forecasts into GFY forecasts is described below. The before- and after-rates volume forecasts presented in my testimony are calculated using the spreadsheets which have been filed in Library Reference LR-I-125 in this case.

**B. Forecast Equation**

The formula for the projection of the volume of mail category  $i$  in postal quarter  $t$  is

$$VOL_{it} = BV_i \cdot VA_i \cdot RM_{it} \cdot NRM_{it} \cdot SE_{it} \cdot SH_{it} \cdot Q_t \quad (1)$$

That is, the volume projection is the product of the Base-Year volume ( $BV_i$ ) and a series of multipliers, including a volume-adjustment multiplier ( $VA_i$ ), a rate-effect

multiplier ( $RM_{it}$ ), a nonrate-effect multiplier ( $NRM_{it}$ ), a seasonal multiplier ( $SE_{it}$ ), a share multiplier ( $SH_{it}$ ), and a quarter length multiplier ( $Q_t$ ). Each of these multipliers will be explained later in this workpaper.

### **C. Base Year and Test Year**

The Base Year for the volume forecast consists of the four Postal quarters ending in 2001Q3. This encompasses the time period from May 20, 2000 through May 18, 2001, and is the sum of 2000Q4, 2001Q1, 2001Q2, and 2001Q3. The Test Year in this case is GFY 2003, which commences on October 1, 2002 and ends on September 30, 2003.

### **D. Outline of the Remainder of This Library Reference**

The remainder of this library reference is organized as follows. In section II, each of the multipliers in equation (1) is described, and quarterly values of each multiplier are presented for single-piece First-Class letters and presort, nonautomated First-Class cards from 2001Q4 through 2005Q1.

In section III.A is an example of how these individual multipliers are brought together to yield quarterly volume forecasts. The methodology used to convert the quarterly volume forecasts into forecasts for GFY 2001 through 2004 is presented in section III.B.

Before- and after-rates volume forecasts are made using the spreadsheets that have been filed in this case as Library Reference LR-I-125.

## II. VOLUME FORECASTING MULTIPLIERS

### A. Base Volume, $BV_i$

The base volume of single-piece First-Class letters is equal to the volume of single-piece First-Class letters in the base period. The base period for this case is 2000Q4 through 2001Q3. The quarterly volume of single-piece First-Class letters for the four quarters of the base period was 14,735.597 million, 11,754.788 million, 13,095.167 million, and 11,787.840 million pieces, respectively. The sum of these numbers is 51,373.392 million pieces, which is the base volume for single-piece First-Class letters.

The base volume for presorted, nonautomated First-Class cards is equal to the volume of total private First-Class cards in the base period. The quarterly volume of private First-Class cards for the four quarters of the base period was 1,541.593 million, 1,315.449 million, 1,177.806 million, and 1,202.647 million pieces, for a total base volume of 5,237.496 million pieces.

### B. Volume Adjustment Multiplier, $V_t$

A volume-adjustment multiplier is used to account for level shifts which are known to have an effect on volumes, which are not implicit in the base volumes. In this case, neither single-piece letters nor presort, nonautomated First-Class cards have volume adjustments. Hence, the value of  $V_t$  is set equal to 1.0 for all time periods for both of these categories of mail.

### C. Rate Effect Multiplier, $RM_{it}$

The rate effect multiplier can be expressed as follows:

$$RM_{it} = PM_{it} \cdot XP_{1it} \cdot XP_{2it} \quad (2)$$

where

$$PM_{it} = (P_{it}/P_{ib})^{e_{i0}} \cdot (P_{i(t-1)}/P_{i(b-1)})^{e_{i1}} \cdot \dots \cdot (P_{i(t-4)}/P_{i(b-4)})^{e_{i4}} \quad (3)$$

$$XP1_{it} = (XP1_{it}/XP1_{ib})^{e_{1i0}} \cdot (XP1_{i(t-1)}/XP1_{i(b-1)})^{e_{1i1}} \cdot \dots \cdot (XP1_{i(t-4)}/XP1_{i(b-4)})^{e_{1i4}} \quad (4)$$

and

$$XP2_{it} = (XP2_{it}/XP2_{ib})^{e_{2i0}} \cdot (XP2_{i(t-1)}/XP2_{i(b-1)})^{e_{2i1}} \cdot \dots \cdot (XP2_{i(t-4)}/XP2_{i(b-4)})^{e_{2i4}} \quad (5)$$

where

$PM_{it}$  is the own-price multiplier,  $P_i$  is the price of mail category  $i$ ,  $e_{ij}$  is the own-price elasticity of mail category  $i$  lagged  $j$  quarters,  $P_{i(b-j)}$  is the base value of price  $i$  lagged  $j$  quarters, and  $XP1$  and  $XP2$  refer to cross-price variables.

In the case of single-piece First-Class letters,  $e_{i0} = -0.168394$ ,  $e_{i1} = -0.143059$ , and  $e_{i2} = e_{i3} = e_{i4} = 0$ ;  $XP1$  is the price of single-piece First-Class cards,  $e_{1i0} = 0.003800$ ,  $e_{1i1} = e_{1i2} = e_{1i3} = e_{1i4} = 0$ ; and  $XP2$  is the First-Class letters worksharing discount, with  $e_{2i0} = -0.027027$ , and  $e_{2i1} = e_{2i2} = e_{2i3} = e_{2i4} = 0$ .

In the case of presort, nonautomated First-Class cards,  $e_{i0} = -0.532605$ ,  $e_{i1} = -0.319366$ ,  $e_{i2} = -0.001163$ ,  $e_{i3} = -0.105558$ , and  $e_{i4} = -0.198286$ ;  $XP1$  is the price of presort, nonautomated First-Class letters,  $e_{1i0} = 0.002002$ ,  $e_{1i1} = 0.040561$ ,  $e_{1i2} = 0.073124$ ,  $e_{1i3} = 0.047236$ , and  $e_{1i4} = 0$ ; and there is no  $XP2$ .

The prices used in forecasting are deflated by the personal consumption deflator, and, in the case of presort, nonautomated First-Class cards, have user costs added to them. Taking these factors into account, the base prices used in forecasting single-piece First-Class letters and presort, nonautomated First-Class cards are summarized in Table 1 below.

**Table 1**  
**Base Prices used in Calculation of Rate Effect Multipliers**  
**for Single-Piece First-Class Letters and Presort, Nonautomated First-Class Cards**

	First-Class Letters			First-Class Cards	
	Single-Piece	Presort Nonauto	Worksharing Discount	Single-Piece	Presort Nonauto
Current	0.386158	0.326598	0.065089	0.190490	0.178519
Lag 1	0.386711	0.325401	NA	NA	0.179219
Lag 2	NA	0.325574	NA	NA	0.180058
Lag 3	NA	0.327276	NA	NA	0.180942
Lag 4	NA	NA	NA	NA	0.182257

The prices used in the forecast period are summarized in Table 2 below.

**Table 2**  
**Prices used in Calculation of Rate Effect Multipliers**  
**for Single-Piece First-Class Letters and Presort, Nonautomated First-Class Cards**

	First-Class Letters			First-Class Cards	
	Single-Piece	Presort Nonauto	Worksharing Discount	Single-Piece	Presort Nonauto
2000Q4	NA	NA	NA	NA	\$0.179862
2001Q1	NA	\$0.323097	NA	NA	\$0.179033
2001Q2	NA	\$0.327934	NA	NA	\$0.177717
2001Q3	\$0.386198	\$0.331058	NA	NA	\$0.177067
2001Q4	\$0.387695	\$0.332162	\$0.063932	\$0.192862	\$0.181418
2002Q1	\$0.388363	\$0.332624	\$0.062929	\$0.195200	\$0.183799
2002Q2	\$0.386596	\$0.331112	\$0.062643	\$0.194312	\$0.182686
2002Q3	\$0.384590	\$0.329393	\$0.062317	\$0.193304	\$0.182171
2002Q4	\$0.382510	\$0.327612	\$0.061980	\$0.192258	\$0.181285
2003Q1	\$0.380289	\$0.325710	\$0.061621	\$0.191142	\$0.180096
2003Q2	\$0.378227	\$0.323944	\$0.061286	\$0.190106	\$0.178855
2003Q3	\$0.376211	\$0.322217	\$0.060960	\$0.189092	\$0.178292
2003Q4	\$0.374026	\$0.320346	\$0.060606	\$0.187994	\$0.177329
2004Q1	\$0.371828	\$0.318463	\$0.060250	\$0.186889	\$0.176168
2004Q2	\$0.369989	\$0.316888	\$0.059952	\$0.185965	\$0.175045
2004Q3	\$0.368190	\$0.315347	\$0.059660	\$0.185061	\$0.174546
2004Q4	\$0.366072	\$0.313533	\$0.059317	\$0.183996	\$0.173591
2005Q1	\$0.363975	\$0.311737	\$0.058977	\$0.182942	\$0.172486

Given these prices and the elasticities summarized above, the rate-effect multipliers for single-piece First-Class letters and presort, nonautomated First-Class cards are summarized in Table 3 below.



**Table 3  
Rate Effect Multipliers**

	<b>Single-Piece First-Class Letters</b>	<b>Presort Nonautomation First-Class Cards</b>
2001Q4	1.000053	0.999689
2002Q1	0.999683	0.988293
2002Q2	1.000310	0.989906
2002Q3	1.001961	0.991545
2002Q4	1.003750	0.988403
2003Q1	1.005650	0.990673
2003Q2	1.007537	0.997037
2003Q3	1.009355	1.001091
2003Q4	1.011255	1.005765
2004Q1	1.013242	1.012192
2004Q2	1.015060	1.018576
2004Q3	1.016730	1.022506
2004Q4	1.018565	1.027383
2005Q1	1.020528	1.033874

**D. Nonrate Effect Multiplier,  $NRM_{it}$**

There are six components of the nonrate effect multiplier for single-piece First-Class letters:

YD96Perm – Long-Run Income

UCAP {lag 4} – Short-Run income, lagged four quarters

CS96C\_INT – Anti-log of Consumption, Internet Service Providers, raised to 0.580145 (see USPS-T-8, section II.B.2.d for explanation)

LT\_WS – Time Trend

LT\_WSQ – Anti-log of Log of Time Trend Squared

N22 – Adult population

There are five components of the nonrate effect multiplier for presort, nonautomated First-Class cards:

YD96Perm

CS96C\_INT

XOD5\_7 – Anti-log of the proportion of mail for which First-Class cards are cheaper than Standard Regular mail

Z\_CARDS – Z-variable for private First-Class cards

N22 – Adult population

For each of these variables, a multiplier is calculated using the following formula:

$$\text{NRM}_{ijt} = (X_{jt} / X_{jb})^{e_{ij}} \quad (6)$$

where  $\text{NRM}_{ijt}$  is the nonrate-effect multiplier at time  $t$  for mail category  $i$  associated with nonrate variable  $j$ ,  $X_{jt}$  is the value of nonrate variable  $j$  at time  $t$ ,  $X_{jb}$  is the value of nonrate variable  $j$  in the base period, and  $e_{ij}$  is the elasticity of category  $i$  with respect to nonrate variable  $j$ .

The values of  $X_{jb}$  are calculated as weighted averages of the Base Year, where the weights used are the number of business days in the particular quarter divided by the total number of business days in the Base Year. Values of  $X_{jt}$  and  $X_{jb}$  are presented in Table 4 below.

For single-piece First-Class letters, the nonrate elasticities are 0.511885, 0.099443, -0.497755, 1.598652, -0.224155, and 1 for YD96Perm, UCAP {lag 4}, CS96C\_INT, LT\_WS, LT\_WSQ, and N22, respectively. For presort, nonautomated First-Class cards, the nonrate elasticities are 0.700151, -0.169642, 0.029514, 1, and 1, for YD96Perm, CS96C\_INT, XOD5\_7, Z\_Cards, and N22, respectively.

**Table 4**  
**Data Used in Calculating Nonrate Multipliers**  
**for Single-Piece First-Class Letters and Presort, Nonautomated First-Class Cards**

Postal Quarter	YD96Perm	UCAP{-4}	CS96C_INT	XOD5_7	Z_Cards	LT_WS	LT_WSQ	N22
2000Q4	33.993	0.804264	1.259116	2.097514	1.257991	97	1.23e+09	188.915
2001Q1	34.172	0.807512	1.293947	2.097514	1.258035	98	1.35e+09	189.333
2001Q2	34.336	0.811309	1.322154	2.278287	1.258074	99	1.48e+09	189.706
2001Q3	34.499	0.817303	1.336156	2.421383	1.258107	100	1.62e+09	190.080
Base Value	34.232	0.809709	1.299791	2.215596	1.258048	98.4	1.41e+09	189.468
2001Q4	34.701	0.817639	1.358646	2.421383	1.258136	101	1.78e+09	190.566
2002Q1	34.919	0.810381	1.385238	2.421383	1.258161	102	1.95e+09	191.124
2002Q2	35.084	0.785904	1.408799	2.421383	1.258183	103	2.13e+09	191.607
2002Q3	35.244	0.772385	1.432134	2.421383	1.258202	104	2.33e+09	192.088
2002Q4	35.409	0.766731	1.458858	2.421383	1.258218	105	2.55e+09	192.606
2003Q1	35.577	0.761976	1.485648	2.421383	1.258233	106	2.79e+09	193.094
2003Q2	35.751	0.758372	1.509031	2.421383	1.258245	107	3.04e+09	193.525
2003Q3	35.936	0.758814	1.532435	2.421383	1.258256	108	3.32e+09	193.957
2003Q4	36.125	0.758560	1.559062	2.421383	1.258265	109	3.62e+09	194.455
2004Q1	36.314	0.757945	1.585832	2.421383	1.258273	110	3.94e+09	194.968
2004Q2	36.506	0.759046	1.609148	2.421383	1.258280	111	4.29e+09	195.412
2004Q3	36.703	0.761087	1.632241	2.421383	1.258286	112	4.67e+09	195.853
2004Q4	36.896	0.761688	1.658598	2.421383	1.258292	113	5.08e+09	196.385
2005Q1	37.091	0.761991	1.685249	2.421383	1.258296	114	5.52e+09	196.959

The nonrate multiplier,  $NRM_{ijt}$ , is then equal to the product of  $NRM_{ijt}$ , for all  $j$ . The final nonrate multipliers used to forecast single-piece First-Class letters and presort, nonautomated First-Class cards are as follows.

**Table 5  
Nonrate Multipliers**

	<b>Single-Piece First-Class Letters</b>	<b>Presort Nonautomation First-Class Cards</b>
2001Q4	0.980905	1.010531
2002Q1	0.972051	1.014614
2002Q2	0.961273	1.017657
2002Q3	0.951981	1.020639
2002Q4	0.942978	1.023534
2003Q1	0.934187	1.026372
2003Q2	0.926606	1.029474
2003Q3	0.919804	1.032815
2003Q4	0.912480	1.036244
2004Q1	0.905319	1.039775
2004Q2	0.899218	1.043426
2004Q3	0.893443	1.047185
2004Q4	0.887124	1.051052
2005Q1	0.881037	1.055164

**E. Seasonal Multiplier,  $SE_{it}$**

The seasonal multiplier is calculated by constructing a seasonal index associated with each mail category. The seasonal index is constructed as the anti-log of the sum of the seventeen econometric seasonal coefficients times the seasonal variables, i.e.,

$$S_t = \exp[b_1 \cdot s_1 + b_2 \cdot s_2 + b_3 \cdot s_3 + \dots + b_{17} \cdot s_{17}] \quad (7)$$

where  $s_1, s_2, s_3, \dots, s_{17}$  are seasonal variables, as described in witness Thress's testimony, and  $b_1, b_2, b_3, \dots, b_{17}$  are coefficients associated with the seasonal variables, and are calculated in witness Thress's testimony.

The seasonal multiplier,  $SE_{it}$ , is calculated by dividing  $S_t$  above by a weighted average of the four preceding quarters,  $S_{bt}$ , where the weights used in the calculation are the quarter-length multipliers,  $Q_{it}$ , described in the next section.

The values of  $S_{it}$ ,  $S_{bt}$ , and  $SE_{it}$  for single-piece First-Class letters are presented below in Table 8.

**Table 8**  
**Seasonal Multipliers for Single-Piece First-Class Letters**

	$S_{it}$	$S_{bt}$	$SE_{it}$
2001Q4	1.032987	1.097117	0.941547
2002Q1	1.073333	1.095129	0.980097
2002Q2	1.220923	1.096004	1.113977
2002Q3	1.081683	1.096872	0.986152
2002Q4	1.030191	1.096020	0.939938
2003Q1	1.064736	1.094048	0.973208
2003Q2	1.216698	1.093079	1.113093
2003Q3	1.086838	1.094299	0.993182
2003Q4	1.030631	1.094433	0.941704
2004Q1	1.056208	1.092477	0.966802
2004Q2	1.204520	1.089683	1.105386
2004Q3	1.091639	1.090819	1.000752
2004Q4	1.032414	1.093926	0.943770
2005Q1	1.054592	1.089775	0.967715

The values of  $S_{it}$ ,  $S_{bt}$ , and  $SE_{it}$  for presort, nonautomated First-Class cards are presented below in Table 9.

**Table 9**  
**Seasonal Multipliers for Presort Nonautomation First-Class Cards**

	$\underline{S}_t$	$\underline{S}_{bt}$	$\underline{SE}_t$
2001Q4	1.006825	1.046236	0.962331
2002Q1	1.182972	1.052717	1.123732
2002Q2	1.027440	1.050346	0.978192
2002Q3	1.000000	1.050346	0.952067
2002Q4	1.006065	1.050114	0.958053
2003Q1	1.197273	1.053395	1.136585
2003Q2	1.017208	1.051047	0.967804
2003Q3	1.000000	1.051047	0.951432
2003Q4	1.006065	1.051047	0.957202
2004Q1	1.211747	1.054368	1.149264
2004Q2	1.007077	1.052044	0.957258
2004Q3	1.000000	1.052044	0.950531
2004Q4	1.004492	1.054059	0.952975
2005Q1	1.197998	1.046611	1.144644

**F. Share Multiplier,  $SH_{it}$**

Single-piece First-Class letters are not subdivided at all in forecasting, and use a base volume based upon single-piece First-Class letters volume. Hence, no share multiplier (i.e., a share multiplier of 100 percent) is used to forecast single-piece First-Class letters volume.

A share multiplier is used, however, in forecasting presort, nonautomated First-Class cards. The share forecasts for presort, nonautomated First-Class cards were developed in witness Thress's testimony, and are summarized in Table IV-6 (for before-rates shares) of his testimony (USPS-T-8). These shares are presented below.

**Table 10**  
**Share Multipliers for Presort, Nonautomated First-Class Cards**

2001Q4	8.665%
2002Q1	9.200%
2002Q2	10.159%
2002Q3	8.319%
2002Q4	7.739%
2003Q1	8.251%
2003Q2	9.274%
2003Q3	7.398%
2003Q4	6.883%
2004Q1	7.364%
2004Q2	8.456%
2004Q3	6.591%
2004Q4	6.170%
2005Q1	6.652%

**G. Quarter Length Multiplier,  $Q_t$**

The purpose of the quarter-length multiplier is to distribute the Postal Year volume forecast into volumes representative of the four postal quarters. For any given quarter, the quarter-length multiplier is equal to the number of business days in the quarter divided by the number of business days in the base year. The same quarter-length multiplier is used in all of the volume forecasts presented in my testimony.

There were 64 business days in 2001Q1 and 2001Q2, 66 business days in 2001Q3, and 85 business days in 2000Q4, for a total of 279 business days in the base year. Table 10 below shows the number of business days in each quarter of the forecast period, as well as the quarter-length multiplier, which is equal to the number of business days divided by 279.

**Table 10**  
**Quarter-Length Multipliers**

<u>Postal Quarter</u>	<u>Business Days</u>	<u>Quarter-Length Multiplier</u>
2001Q4	85	0.304659
2002Q1	64	0.229391
2002Q2	64	0.229391
2002Q3	66	0.236559
2002Q4	85	0.304659
2003Q1	64	0.229391
2003Q2	64	0.229391
2003Q3	66	0.236559
2003Q4	85	0.304659
2004Q1	64	0.229391
2004Q2	64	0.229391
2004Q3	66	0.236559
2004Q4	86	0.308244
2005Q1	63	0.225806

### III. VOLUME PROJECTION

#### A. Calculation of Quarterly Volume Forecasts

Given the values presented in section II, quarterly volume forecasts are made by solving equation (1) above, which is reprinted here for convenience.

$$VOL_{it} = BV_i * VA_i * RM_{it} * NRM_{it} * SE_{it} * SH_{it} * Q_t \quad (1)$$

For example, for 2003Q1 the volume forecast for single-piece First-Class letters is equal to the following:

$$51,373.392 * 1 * 1.005650 * 0.934187 * 0.973208 * (100\%) * 0.229391 = 10,774.577$$

In 2003Q1, the volume forecast for presort, nonautomated First-Class cards is equal to the following:

$$5,237.496 * 1 * 0.990673 * 1.026372 * 1.136585 * (8.251\%) * 0.229391 = 114.566$$



### B. Calculation of Government Fiscal Year (GFY) Volume Forecasts

Volume forecasts for government fiscal year T, for T = 2001 through 2004 were calculated from the quarterly volume forecasts as follows:

$$V_T = (1-S_T) \cdot V_{TQ1} + V_{TQ2} + V_{TQ3} + V_{TQ4} + S_{T+1} \cdot V_{(T+1)Q1} \quad (8)$$

where  $S_T$  is the percentage of quarter 1 of Postal Fiscal Year T that falls before October 1<sup>st</sup> (the first day of the government fiscal year). For T = 2001 and T = 2002,  $S_T = (17/66)$ , while for T = 2003,  $S_T = (18/66)$ , for T = 2004,  $S_T = (19/66)$ , and for T = 2005,  $S_T = (19/66)$ .

Hence, for example, the volume in GFY 2003 is calculated using the following formula:

$$V_{GFY2003} = (48/66) \cdot V_{2003Q1} + V_{2003Q2} + V_{2003Q3} + V_{2003Q4} + (19/66) \cdot V_{2004Q1} \quad (9)$$

The calculation of GFY 2002 and GFY 2003 after-rates volumes is complicated slightly. For this case, it was assumed that R2001-1 rates took effect on October 1, 2002, which falls during 2003Q1. Hence, 2003Q1 volumes are affected by the proposed rate change. The proposed rate change occurs after GFY 2002, however, which ends on September 30, 2002. Hence, the value of  $S_{2003}$  was recalculated in this case, such that after-rates volume forecasts for GFY 2002 are exactly equal to the before-rates volume forecasts for GFY 2002. Hence, a unique value of  $S_{2003}$  was calculated for each mail category. By recalculating  $S_{2003}$  in this way, the volume forecasts for GFY 2003 are also affected through equation (8) above.