

## Depreciation

Depreciation of an asset allows periodic allocation of the cost of the asset. Tax law and accounting students use many methods for assigning the cost of an asset to the period during which it is used.

### Objectives:

- Determine the values and new basis for each year when an asset is depreciated.
- Explore different methods of depreciation.

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## Straight Line Depreciation

### Example 1:

XYZ corporation wishes to depreciate a \$1,000 printer over its 5-year life using straight line depreciation. Calculate the values and the new basis for each year.

Let:         $N$  = Useful life of asset in years

$B$  = Basis of the asset

$S$  = Salvage value

$TD$  = Total depreciation allowed

Total depreciation allowed on an item is:

$$TD = B - S$$

In these examples, salvage is assumed to be zero. For straight line depreciation:

$$TD = 1000 - 0 \text{ or } 1000$$

$$N = 5$$


$$\text{Periodic (annual depreciation)} = 1000/5$$

The adjusted basis  $B(Y)$  at the end of year  $Y$  is:

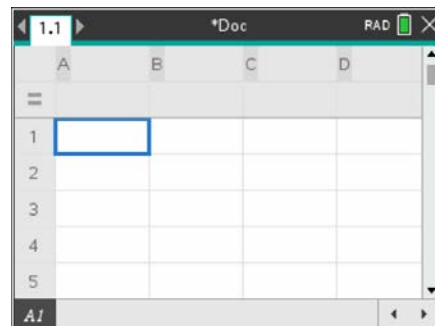
$$B(Y) = 1000(1 - Y*(1/N))$$

Straight line depreciation assigns  $1/5$  of the basis value to each of the 5 years.



The Lists & Spreadsheet application will be used to construct a depreciation table.

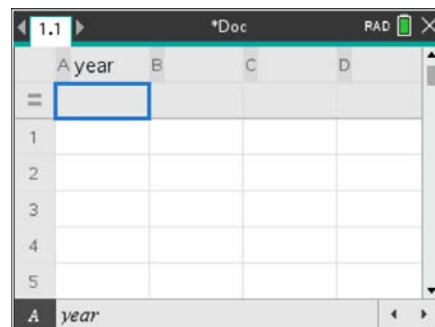
1. Press , and select **New** to start a new document. Select **Add Lists & Spreadsheet**.

**Note:** To round computations to two decimal places, change the Display Digits setting in the Documents Settings to **Fix 2**.

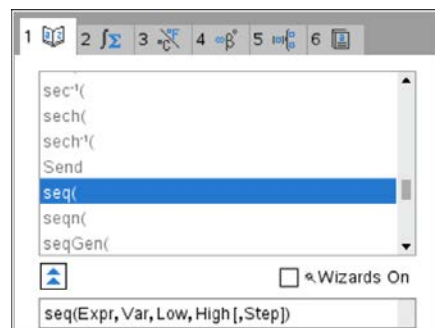


The first column will store the numbers for the years.

2. Arrow to the top of the first column, and enter the list name *year*.
3. With the cursor in the formula cell, press  (the catalog key) and then press **S** to move to catalog entries that begin with the letter **s**. Arrow down to **seq(** and press  to select **seq(**.

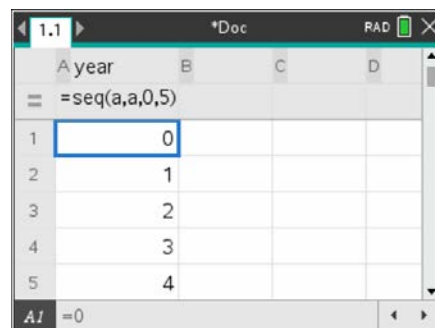


The syntax for this command is **seq(Exp, Var, Low, High [,Step])**. The default Step value is 1.



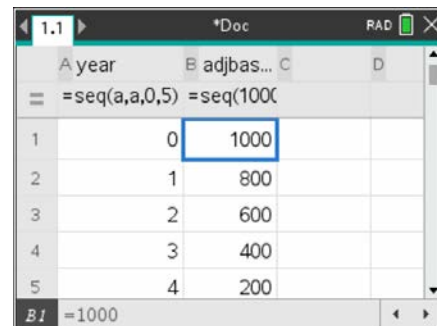
4. Complete the expression by entering **A** **,** **A** **,** **0** **,** **5**. Press .

**Note:** The sequence command can be entered by pressing the letters **seq** and the left parenthesis key. The right parenthesis is shown when the left parenthesis key is selected.

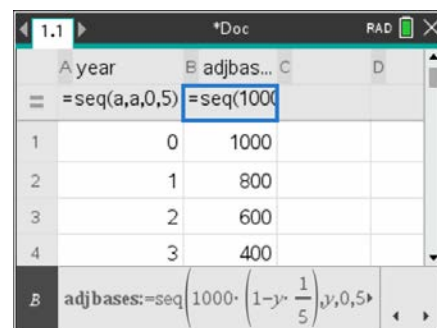


The second column will be the annual adjusted bases.

5. Arrow to the top of the second column and name the list *adjbases*.
6. In the formula cell, enter **seq(1000(1-Y\*(1/5)),Y,0,5)** and press **enter**.



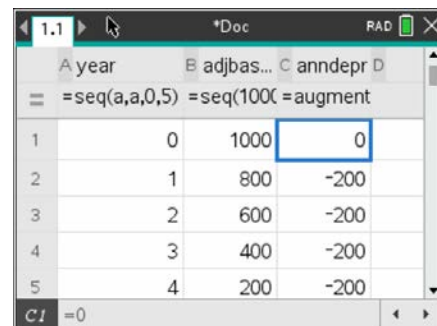
A	year	B	adjbas...	C	D
=		=seq(a,a,0,5)	=seq(1000		
1	0	1000			
2	1	800			
3	2	600			
4	3	400			
5	4	200			
B1		=1000			



A	year	B	adjbas...	C	D
=		=seq(a,a,0,5)	=seq(1000		
1	0	1000			
2	1	800			
3	2	600			
4	3	400			
B		adjbases:=seq(1000*(1-Y*(1/5)),Y,0,5)			

The third column will display the annual depreciation, which is the difference between the adjusted bases for consecutive years. Note that no depreciation is allowed for year 0. To set up the annual depreciation list, use the **augment** and **ΔList** functions. For an explanation of these functions, see the Handheld Housekeeping Detail section that follows this example.

7. Arrow to the top of the third column and name the list *anndepr*.
8. In the formula cell, enter **augment({0}, ΔList(adjbases))** and press **enter**.




A	year	B	adjbas...	C	anndepr	D
=		=seq(a,a,0,5)	=seq(1000	=augment		
1	0	1000		0		
2	1	800		-200		
3	2	600		-200		
4	3	400		-200		
5	4	200		-200		
C1		=0				

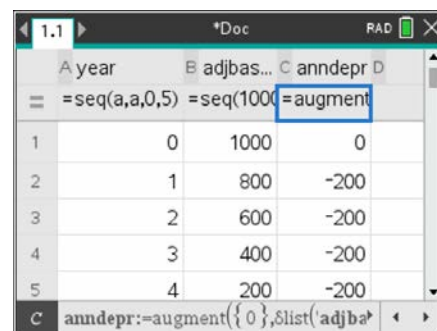
The **augment** function is accessed by pressing **Menu > Data > List Operations** and selecting **Augment**.

To enter {0}, press **ctrl** **)** **0**.

**ΔList** (difference list) is accessed by pressing **Menu > Data > List Operations** and selecting **Difference List**.

To enter the list name *adjbases*, type the name or press **var** and select **adjbases**.








**Note:** **ΔList** can also be accessed by pressing  **D**, arrowing down to **deltaList**, and pressing **enter**. (The syntax for deltaList is deltaList(List).)




A	year	B	adjbas...	C	anndepr	D
=		=seq(a,a,0,5)	=seq(1000	=augment		
1	0	1000		0		
2	1	800		-200		
3	2	600		-200		
4	3	400		-200		
5	4	200		-200		
C		anndepr:=augment({0},Δlist('adjba				

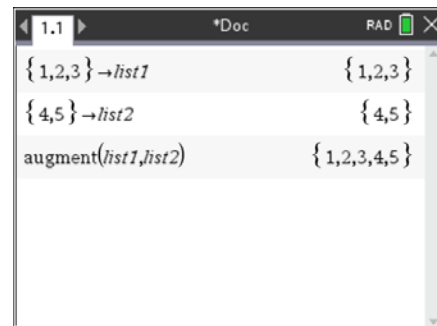
### Handheld Housekeeping Detail

The **augment**(List1,List2) command concatenates List1 and List2, creating a new list with the elements of List1 followed by the elements in List2. For example, if List1 = {1,2,3} and List2 = {4,5} then **augment(List1, List2)** would produce {1,2,3,4,5}.

1. Press , and select **New** to start a new document. Select **Add Calculator**.
2. To enter {}, press  . Enter the values shown, each separated by a comma. To store the list, press the right arrow key and then press  . Enter a list name, and press .
3. Repeat to store the values shown to a second list.
4. Press **Menu > Statistics > List Operations**, and select **Augment**.
5. Enter the name of the first list, followed by a comma. Enter the name of the second list and press .

Type the list names or press  to select each list name.


The result is a list containing {1,2,3,4,5}.

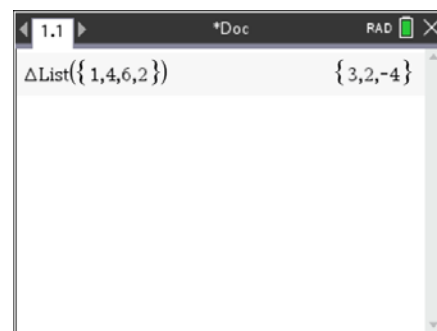


Another interesting operation is the  $\Delta$ List command. This operation creates a new list in which each element is the difference of successive elements in the list.

$\Delta$ List(List1) = {List1(2) – List1(1), List1(3) – List1(2), etc.}

$\Delta$ List({1,4,6,2}) yields the list {3,2,-4}. The new list will always have one less element in it than the original list.

1. On a Calculator page, press **Menu > Statistics > List Operations**, and select **Difference List**.
2. Enter {1,4,6,2} and press .



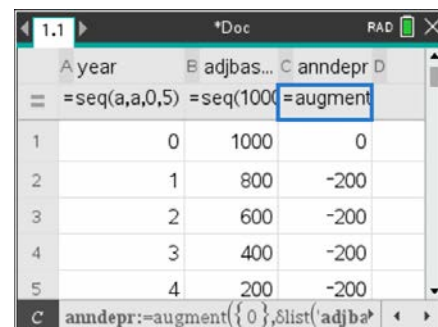
In the earlier straight line depreciation example, the third column of the depreciation table showed the annual depreciation for each of the years 0 to 5.

The *anndepr* list was generated by the expression

**augment({0}, ΔList(*adjbases*)).**

Observe that *anndepr* is a list of the differences in the annual adjusted bases except for the first element 0, which is the depreciation for year 0.

*adjbases*(2) – *adjbases*(1) is the depreciation allowed in year 1. *adjbases*(3) – *adjbases*(2) is the depreciation allowed in year 2, etc. **ΔList(*adjbases*)** does this calculation automatically and was used to calculate the depreciation for years 1 through 5. The depreciation for year 0 is 0.



A year	B adjbas...	C anndepr	D
=	=seq(a,a,0,5)	=seq(1000,=augment	
1	0	1000	0
2	1	800	-200
3	2	600	-200
4	3	400	-200
5	4	200	-200
C	anndepr:=augment({0},ΔList('adjba'		


### Sum of the Digits Method of Depreciation

A classic depreciation technique is called the sum of the digits method and computes a different fractional depreciation for each year. The denominator of each fraction is the sum of the digits from 1 to N where N is the number of years in the life of the asset. The numerator is N – Y + 1, where Y is the period number.

#### Example 2:

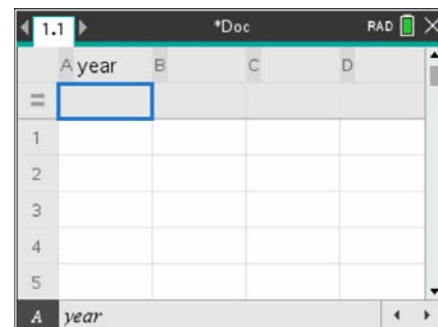
Show a depreciation table for a sum of the digits method for 5 years on a \$1,000 printer.

The depreciation table will consist of four columns.


- Press , and select **New** to start a new document. Select **Add Lists & Spreadsheet**.

**Note:** To round computations to two decimal places, change the Display Digits setting in the Documents Settings to **Fix 2**.

- The first list is the year. Arrow to the top of the first column, and enter the list name *year*.

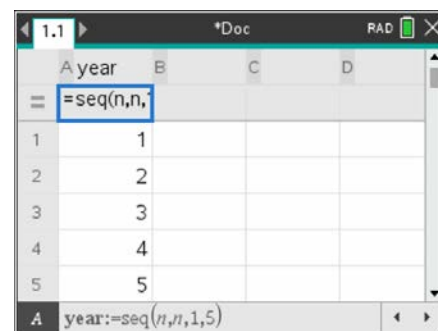


A year	B	C	D
=			
1			
2			
3			
4			
5			
A	year		

- With the cursor in the formula cell, press  (the catalog key) and then press **S** to move to catalog entries that begin with the letter **s**. Arrow down to **seq(** and press **enter** to select **seq(**.

The syntax for this command is **seq(Exp, Var, Low, High, [Step])**. The default Step is 1.

Complete the command by entering **N** , **N** , 1 , 5 and press **enter**.



A year	B	C	D
=	=seq(n,n,		
1	1		
2	2		
3	3		
4	4		
5	5		
A	year:=seq(n,n,1,5)		

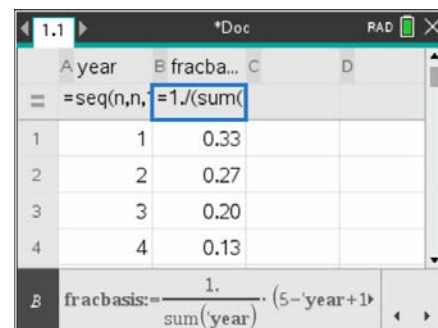
The second list is the fraction of the basis taken as depreciation for each year. The numerator of the fraction is  $5 - Y + 1$  and the denominator is the sum of the digits 1 through 5.

4. Arrow to the top of the second column, and enter the list name *fracbasis*.
5. In the formula cell, enter **(1.0/sum(year)\*(5-year+1))** and press **enter**.

The **sum** function is accessed by pressing **Menu > Data > List Math** and choosing **Sum of Elements**.

To enter *year*, type the list name *year* or press **var** and select **year**.

**Note:** Placing a decimal point in one of the numbers in the computation will result in decimal approximations rather than exact answers.



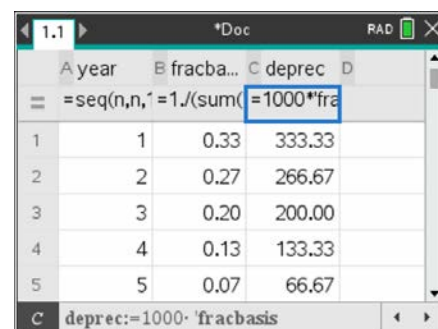
A year	B fracba...	C	D
=seq(n,n,1,5)	=1./sum('		
1	0.33		
2	0.27		
3	0.20		
4	0.13		

Formula bar:  $\text{fracbasis} = \frac{1.}{\text{sum}(\text{year})} \cdot (5 - \text{year} + 1)$

The third list is the depreciation, the original basis multiplied by the factor in the second list, *fracbasis*.

6. Arrow to the top of the third column, and enter the list name *deprec*.
7. In the formula cell, enter **1000\*fracbasis**, and press **enter**.

To enter *fracbasis*, type the list name *fracbasis* or press **var** and select **fracbasis**.



A year	B fracba...	C deprec	D
=seq(n,n,1,5)	=1./sum('	=1000*fra	
1	0.33	333.33	
2	0.27	266.67	
3	0.20	200.00	
4	0.13	133.33	
5	0.07	66.67	

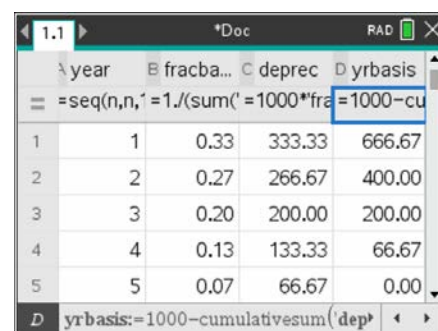
Formula bar:  $\text{deprec} = 1000 \cdot \text{fracbasis}$

The fourth list gives the basis at the end of each year and equals the original basis less the depreciation already taken.

8. Arrow to the top of the fourth column, and enter the list name *yrbasis*.
9. In the formula cell, enter **1000-cumulativeSum(deprec)**, and press **enter**.

The **cumulativeSum** command can be accessed by pressing **Menu > Data > List Operations** and choosing **Cumulative Sum List**.

To enter *deprec*, type the list name *deprec* or press **var** and select **deprec**.



A year	B fracba...	C deprec	D yrbasis
=seq(n,n,1,5)	=1./sum('	=1000*fra	=1000-cu
1	0.33	333.33	666.67
2	0.27	266.67	400.00
3	0.20	200.00	200.00
4	0.13	133.33	66.67
5	0.07	66.67	0.00

Formula bar:  $\text{yrbasis} = 1000 - \text{cumulativeSum}(\text{deprec})$

### Double Declining Balance Depreciation

This depreciation method is allowed by the tax code and gives a larger depreciation in the early years of an asset. Unlike the straight line and the sum of the digits methods, both of which use the original basis to calculate the depreciation each year, the double declining balance uses a fixed percentage of the prior year's basis to calculate depreciation. The percentage rate is  $2/N$  where  $N$  is the life of the asset. With this method, the basis never becomes zero. Consequently, it is standard practice to switch to another depreciation method as the basis decreases. Usually the taxpayer will convert to the straight line method when the annual depreciation from the declining balance becomes less than the straight line.

For example, if the life of an asset is 5 years, straight line depreciation allows  $1/5$  or 20% of the basis as depreciation each year. Thus, a \$1,000 basis depreciates \$200 per year. The double declining balance method allows  $2/5$  or 40%, double the straight line rate, of the current basis each year. In this example,

40% of \$1000 = \$400 in year 1,

40% of \$600 = \$240 in year 2, and

40% of \$360 = \$144 in year 3.


The double declining balance method relies on the new basis each year. This calculation is similar to finding compound interest.

YEAR	BASIS
0	1000
1	$1000(1 - 0.4)$
2	$(1000(1 - 0.4))(1 - 0.4) = 1000(1 - 0.4)^2$
3	$(1000(1 - 0.4))(1 - 0.4)(1 - 0.4) = 1000(1 - 0.4)^3$


Note that if the life had been 8 years, then straight line depreciation would allow only 12.5% of the original basis per year while the double declining balance would allow 25%.

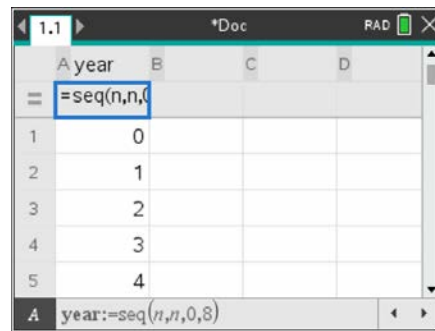
### Example 3:

Calculate double declining balance depreciation for an item with useful life of 8 years and a basis of \$1,000.

- Press , and select **New** to start a new document. Select **Add Lists & Spreadsheet**.

**Note:** To round computations to two decimal places, change the Display Digits setting in the Documents Settings to **Fix 2**.

- Arrow to the top of the first column, and enter the list name *year*.
- In the formula cell, enter **seq(N,N,0,8)**, and press .



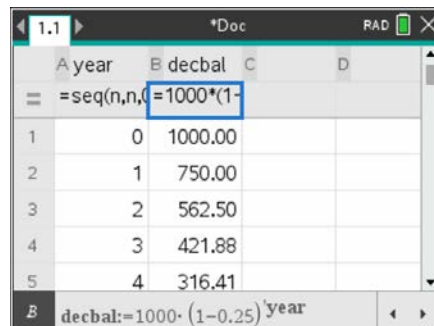
A	year	B	C	D
=	=seq(n,n,0,8)			
1	0			
2	1			
3	2			
4	3			
5	4			

At the bottom of the screen, the formula bar shows: **year:=seq(n,n,0,8)**

4. The second list is the declining balance. Arrow to the top of the second column, and enter the list name *decbal*.

5. In the formula cell, enter **1000(1-0.25)^year**, and press **enter**.

To enter *year*, type the list name *year* or press **var** and select **year**.



A	year	B	decbal	C	D
=					
1	0		1000.00		
2	1		750.00		
3	2		562.50		
4	3		421.88		
5	4		316.41		

Formula:  $\text{decbal} = 1000 \cdot (1 - 0.25)^{\text{year}}$

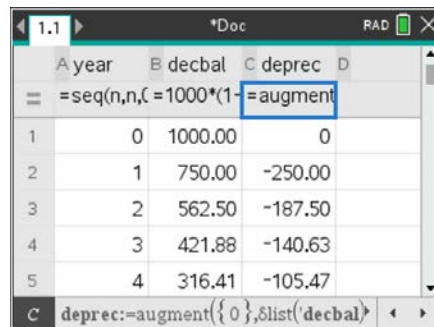
6. The third list is the depreciation allowed. Arrow to the top of the third column, and enter the list name *deprec*.

7. In the formula cell, enter **augment({0}, ΔList(*decbal*))** and press **enter**.

The **augment** function is accessed by pressing **Menu > Data > List Operations** and selecting **Augment**.

**ΔList** (difference list) is accessed by pressing **Menu > Data > List Operations** and selecting **Difference List**.

To enter *decbal*, type the list name *decbal* or press **var** and select *decbal*.



A	year	B	decbal	C	deprec	D
=						
1	0		1000.00		0	
2	1		750.00		-250.00	
3	2		562.50		-187.50	
4	3		421.88		-140.63	
5	4		316.41		-105.47	

Formula:  $\text{deprec} = \text{augment}(\{0\}, \Delta \text{List}(\text{decbal}))$