Example 1: Product mix problem with diminishing profit margin.

Your company manufactures TVs, stereos and speakers, using a common parts inventory of power supplies, speaker cones, etc. Parts are in limited supply and you must determine the most profitable mix of products to build. But your profit per unit built decreases with volume because extra price incentives are needed to load the distribution channel.

			TV set	*Stereo*	*Speaker*
		Number to Build->	100	100	100
Part Name	*Inventory*	*No. Used*			
Chassis	450	200	1	1	0
Picture Tube	250	100	1	0	0
Speaker Cone	800	500	2	2	1
Power Supply	450	200	1	1	0
Electronics	600	400	2	1	1
			Profits:		
		By Product	$4,732	$3,155	$2,208
		Total	**$10,095**		

Diminishing Returns Exponent: 0.9

Example 2: Transportation Problem.

Minimize the costs of shipping goods from production plants to warehouses near metropolitan demand centers, while not exceeding the supply available from each plant and meeting the demand from each metropolitan area.

		Number to ship from plant x to warehouse y (at intersection):				
Plants:	*Total*	*San Fran*	*Denver*	*Chicago*	*Dallas*	*New York*
S. Carolina	5	1	1	1	1	1
Tennessee	5	1	1	1	1	1
Arizona	5	1	1	1	1	1
Totals:		3	3	3	3	3
Demands by Whse -->		180	80	200	160	220
Plants:	*Supply*	*Shipping costs from plant x to warehouse y (at intersection):*				
S. Carolina	310	10	8	6	5	4
Tennessee	260	6	5	4	3	6
Arizona	280	3	4	5	5	9
Shipping:	**$83**	$19	$17	$15	$13	$19

Example 3: Personnel scheduling for an Amusement Park.

For employees working five consecutive days with two days off, find the schedule which meets demand from attendance levels while minimizing payroll costs.

Sch.	***Days off***	***Employees***	***Sun***	***Mon***	***Tue***	***Wed***	***Thu***	***Fri***	***Sat***
A	*Sunday, Monday*	4	0	0	1	1	1	1	1
B	*Monday, Tuesday*	4	1	0	0	1	1	1	1
C	*Tuesday, Wed.*	4	1	1	0	0	1	1	1
D	*Wed., Thursday*	6	1	1	1	0	0	1	1
E	*Thursday, Friday*	6	1	1	1	1	0	0	1
F	*Friday, Saturday*	4	1	1	1	1	1	0	0
G	*Saturday, Sunday*	4	0	1	1	1	1	1	0
	Schedule Totals:	32	24	24	24	22	20	22	24
	Total Demand:		22	17	13	14	15	18	24
	Pay/Employee/Day:	$40							
	Payroll/Week:	**$1,280**							

Example 4: Working Capital Management.

Determine how to invest excess cash in 1-month, 3-month and 6-month CDs so as to maximize interest income while meeting company cash requirements (plus safety margin).

	Yield	*Term*
1-mo CDs:	1.0%	1
3-mo CDs:	4.0%	3
6-mo CDs:	9.0%	6

Purchase CDs in months:
1, 2, 3, 4, 5 and 6
1 and 4
1

Interest Earned:

Total **$7,700**

Month:	***Month 1***	***Month 2***	***Month 3***	***Month 4***	***Month 5***	***Month 6***	***End***
Init Cash:	$400,000	$205,000	$216,000	$237,000	$158,400	$109,400	$125,400
Matur CDs:		100,000	100,000	110,000	100,000	100,000	120,000
Interest:		1,000	1,000	1,400	1,000	1,000	2,300
1-mo CDs:	100,000	100,000	100,000	100,000	100,000	100,000	
3-mo CDs:	10,000			10,000			
6-mo CDs:	10,000						
Cash Uses:	75,000	(10,000)	(20,000)	80,000	50,000	(15,000)	60,000
End Cash:	$205,000	$216,000	$237,000	$158,400	$109,400	$125,400	$187,700

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Example 5: Efficient stock portfolio.

Find the weightings of stocks in an efficient portfolio which maximizes the portfolio rate of return for a given level of risk. This worksheet uses the Sharpe single-index model; you can also use the Markowitz method if you have covariance terms available.

Risk-free rate	6.0%	*Market variance*	3.0%
Market rate	15.0%	*Maximum weight*	100.0%

	Beta	*ResVar*	*Weight*	**Beta*	**Var.*
Stock A	0.80	0.04	20.0%	0.160	0.002
Stock B	1.00	0.20	20.0%	0.200	0.008
Stock C	1.80	0.12	20.0%	0.360	0.005
Stock D	2.20	0.40	20.0%	0.440	0.016
T-bills	0.00	0.00	20.0%	0.000	0.000
Total			100.0%	1.160	0.030

	Return	***Variance***
Portfolio Totals:	**16.4%**	***7.1%***

Maximize Return: A21:A29	**Minimize Risk: D21:D29**
0.1644	0.07077
5	5
1	1
1	1
1	1
1	1
1	1
1	1
1	1

Example 6: Value of a resistor in an electrical circuit.

Find the value of a resistor in an electrical circuit which will dissipate the charge to 1 percent of its original value within one twentieth of a second after the switch is closed.

```
                Switch->
   |-----         \            ---------      ----|
   |               \                              |
   |               |                              |
Battery        Capacitor (C)                Inductor (L)
   |               |                              |
   |               |                              |
   |-----       ----|----       Resistor-      ----|
                                  (R)
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q0 =	9	volts
q[t] =	0.09	volts
t =	0.05	seconds
L =	8	henrys
C =	0.0001	farads
R =	300	ohms
q[t] =	0.25389	

1/(L*C)	1250
(R/(2*L))^2	351.5625
SQRT(B15-B16)	29.97395
COS(T*B17)	0.072037
-R*T/(2*L)	-0.9375
Q0*EXP(B19)	3.524451