1. Duckwheat Transportation Costs

D = (Kansas + Mexico) − (New York + California)

Kansas: +15 ; Mexico: 8 ; New York: 10 ; California: 13

Production ; Consumption

Kansas → New York = 2 $ / duckwheat

Kansas → California = 3 $ / duck

Mexico → New York = 4 $ / duck

Mexico → California = 1 $ / duck

x = Kansas

y = Mexico

C = Transportation costs = $2x_n + 3x_c + 4y_n + 1y_c$

Minimize

x_n, x_c, y_n, y_c

$x + y \geq$ New York + California

$x + y \geq 10 + 13 = 23$

$x \leq 15$ $\quad x \geq 0$

$y \leq 8$ $\quad y \geq 0$

$\min D(c) = 2x_n + 3x_c + 4y_n + 1y_c$

2.

n actors

actor i charges s_i dollars

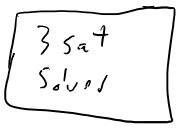
m available investors

j will provide p_j dollars but only if

$\subseteq_j \{1, 2, \ldots, n\}$ actors are cast

$$\text{Profit} = \sum_{i=1}^{m} p_i - \sum_{i=1}^{n} s_i$$

$$\text{Max} \left\{ \sum_{i=1}^{m} p_i - \sum_{i=1}^{n} s_i \right\} \quad \text{for} \quad \{0,1\} \text{ s.t.}$$

3. a) Problem X → 

✓

i. True

ii. True

b)

i. True

c)

i. True

4. Ingredients $\Lambda \{n_1, n_2, \ldots, n_{1c}\}$

$B = n \times n$ matrix

input = B

output = max number of Combinations

in \ n	n_1	n_2	n_3	n_4	n_5	n_6
n_1	O					
n_2		O				
n_3			O			
n_4				O		
n_5					O	
n_6						O

Show that if P can be solved in polynomial time, then P = NP

We can show this problem, EXP, is a problem in NP as we could fill the matrix in n^2 time, however, finding the solution to our problem, max ingredients ~~....~~ that go together is extremely large, and nondeterministic.

We can prove this by reducing a SAT problem to the binary Matrix, therefore showing EXP is at least as hard as SAT, which is NP-Hard

Our SAT problem could be a combination of pairs of unprecedented $n_1, n_2, \ldots, n_k$

Example: $(n_1 \wedge n_2) \vee (n_1 \wedge n_3) \vee \ldots \vee (n_1 \wedge n_k)$

Many combinations $(n_2 \wedge n_1) \vee (n_2 \wedge n_3) \ldots$

$(n_3 \wedge n_1) \vee (n_3 \wedge n_2 \wedge \overline{n_1}) \wedge$

$(n_k \wedge n_1) \vee \ldots \vee (n_k \wedge n_{k-1})$

We can then verify that this can translate to a matrix showing all possibilities and combinations

Therefore, $EXP \geq SAT$, and therefore EXP is NP-Hard, or SAT is NP-Hard