ALLOTROPE PARTNERS:
IEOR115 TEAM 4 FINAL PRESENTATION
THE CLIENT
ALLOTROPE PARTNERS.
a specialized merchant bank.

supports sustainable energy
finances projects around the world
invests in companies & technologies
EER DIAGRAM & RELATIONAL SCHEMA
1) REGION (RgnID, Name, Population, Political_Environment, Climate, Energy_Source, Electricity_Cost_Per_MW)

2) COUNTRY (Country_Code, Name, Govt_Type, Area, GDP, Part_of_RegionID, Population, GDP_Per_Capita, Primary_Energy_Source, President, Interest_Level)

3) POLICY (PolID, Tax Impact, Purpose, Branch_of_Govt, Date_Proposed, Date_in_Effect, Region)
   a) Environmental_Regulation (PolID)
   b) Tariff_Incentives (PolID, Incentive_Category, Length_of_Contract)
   c) Other (PolID)

4) INVESTMENT (IID, Amount, Date, Stage, Time Frame, Status, Predicted_MW_Output, Predicted_Cost_Per_MW, Return)
   a) Hard_Asset_Project(IID, Name, Start_Date, Finish_Date)
   b) Startup_Company(IID, Age)

5) FUND (FundID, Amount, Date_In, Date_Out)

6) COMPANY (EIN, Name)
7) **PERSON** (SSN, Name, Email, Position)
   a) Representative (SSN\(^7\), Company\(^6\))
   b) Private_Investor (SSN\(^7\))
   c) Allotrope_Employee (SSN\(^7\))
   d) Journalist (SSN\(^7\))
   e) Advisor (SSN\(^7\))

8) **TECHNOLOGY** (TID, Name)

9) **INDUSTRY** (IndID, Name)

10) **RESEARCH** (RID, Summary, Comments, Date)
   a) News_article(RID\(^{10}\), URL)
   b) Conversation(RID\(^{10}\))

11) **SIGNIFICANCE_LEVEL** (SLID, RID\(^{10}\), TID\(^8\), SSN\(^{7c}\), Score, date_of_input)

12) **CASH_FLOW** (CFID, IID\(^4\), CFYear, IRR, F_cash1, F_cash2)
   a) Inflow (CFID, InflowID, Total_Inflow, Terminal_Value)
   b) (CFID, OutflowID, Initial_Investment, Operating_Cost, Tax_Expense, Interest_Expense)
13) **PERSON_LIVES_IN_REGION** (RgnID¹, SSN⁷)

14) **TECHNOLOGY_RELATES_TO_RESEARCH** (TID⁸, RID¹⁰)

15) **COUNTRY_HAS_POLICY** (Country_Code², PolicyID³, Discount_Rate)

16) **COUNTRY_RelATES_TO_RESEARCH** (Country_Code², RID¹⁰)

17) **PERSON_HAS_CONVERSATION** (SSN⁷, RID¹⁰b)

18) **PERSON_HAS_EXPERTISE_IN_INDUSTRY** (SSN⁷, IndID⁹)

19) **PERSON_HAS_EXPERTISE_IN_TECHNOLOGY** (SSN⁷, IndID⁹)

20) **PERSON_WORKS_WITH_INVESTMENT** (SSN⁷, IID⁴)

21) **INVESTMENT_INVOLVES_TECHNOLOGY** (IID⁴, TID⁸)

22) **INDUSTRY_HAS_INVESTMENT** (IndID⁹, IID⁴)

23) **COUNTRY_HAS_INVESTMENT** (Country_Code², IID⁴)

24) **RESEARCH_RELATES_TO_INDUSTRY** (RID¹⁰, IID⁴)

25) **RESEARCH_RELATES_TO_POLICY** (RID¹⁰, PolID³)

26) **JOURNALIST_WRITES_NEWS_ARTICLE** (SSN⁷d, RID¹⁰a)
27) ADVISOR_ADVISES_EMPLOYEES (SSN^7e, SSN^7c)
28) EMPLOYEE_COLLECTS_RESEARCH (SSN^7c, RID^10)
29) EMPLOYEE_CONTACTS_REPRESENTATIVES (SSN^7a, SSN^7c)
30) EMPLOYEE_CONTACTS_PRIVATE_INVESTOR (SSN^7b, SSN^7c)
31) COMPANY_INVESTS_CAPCONTRIBUTION (EIN^6, ContributionID^34, Private_investor^7b)
32) PRIVATE_INVESTOR_INVESTS_CAPCONTRIBUTION (EIN^6, ContributionID^34, Private_investor^7b)
33) CAPCONTRIBUTION_GOES_INTO_FUND (ContributionID^34, Private_investor^7b, FundID^5, Date, Amount)
34) FUND_INVESTS_IN_INVESTMENT (FundID^5, IID^4)
35) COMPANY_OWNS_HARD_ASSET_PROJECT (EIN^6, IID^4a)
36) CAPCONTRIBUTION (ContributionID, Private_investor^7b, Amount, Date)
37) RESEARCH_HAS_SIGNIFICANCE_LEVEL (RID^10, SLID^11)
38) ALLOTROPE_EMPLOYEE_ASSIGNS_SIGNIFICANCE_LEVEL (SLID^11, SSN^7c)
39) COMPANY_IS_IN_REGION (EIN^6, RgnID^1)
QUERIES

QUERY 1
Forecasting Returns for Projects

QUERY 2
Tracking Important Technologies

QUERY 3
Identifying Important Research

QUERY 4
Analyzing Policy Effects on Projects

QUERY 5
Identifying Promising Regions
FORECASTING RETURNS FOR PROJECTS

(1) export cash flows

(2) calculate IRR

(3) generate future returns and rank projects by IRR

(4) generate graphs
(1) export cash flows

**SELECT**

- C.IID,
- C.Year,
- I.Total_Inflow + O.Total_Outflow AS Net_Flow
- IVT.Amount as Initial_Investment

**FROM**

- Cash Flow AS C,
- Inflow AS I,
- Outflow AS O,
- Investment AS IVT

**WHERE**

- C.CFID = I.CFID AND
- C.CFID = O.CFID;
(2) calculate IRR
(3) generate future returns and rank projects by IRR

<table>
<thead>
<tr>
<th>IRR Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IID</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>Initial Investment</td>
</tr>
<tr>
<td>2008</td>
</tr>
<tr>
<td>2009</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>2011</td>
</tr>
<tr>
<td>Initial Investment</td>
</tr>
<tr>
<td>2009</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>Initial Investment</td>
</tr>
<tr>
<td>2007</td>
</tr>
<tr>
<td>2008</td>
</tr>
<tr>
<td>2009</td>
</tr>
<tr>
<td>Initial Investment</td>
</tr>
<tr>
<td>2013</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inadequate Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>IID</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>8</td>
</tr>
</tbody>
</table>
QUERY 1: Forecasting Returns on Projects

2014 Projected Returns on Projects

Value of Investment

Year

2010 2011 2012 2013 2014

0 250000 500000 750000 1000000

7 4
TRACKING IMPORTANT TECHNOLOGIES

(1) find avg significance level
(2) find frequency
(3) measure how recent it was mentioned
(4) measure total size of investments
(5) put (1)–(4) in a table
(6) generate final score
(7) rank each technology
(1) find avg significance level

**SELECT**

distinct SL.TID,

avg(SL.Score)

**FROM** Significance_level as SL

**GROUP BY** SL.TID

**ORDER BY** avg(SL.Score) DESC;
(2) find frequency

SELECT
  distinct SL.TID,
  count(SL.RID)
FROM Significance_level as SL
GROUP BY SL.TID
ORDER BY count(SL.Score) DESC;
(3) measure how recent it was mentioned

```
SELECT
    distinct SL.TID,
    sum(r.rdate-date())
FROM
    Significance_level as SL,
    Research as R
WHERE
    R.RID=SL.RID
GROUP BY
    SL.TID
ORDER BY
    sum(r.rdate-date()) DESC;
```

Note: “date()” is going to be updated based on the date the query is run.
(4) measure total size of investments

**SELECT**
- distinct IT.TID,
- sum(l.amount)

**FROM**
- Investment as I,
- Investment_involves_technology as IT

**WHERE** I.IID=IT.IID

**GROUP BY** IT.TID

**ORDER BY** sum(l.amount) DESC;
(5) put (1)–(4) in a table

<table>
<thead>
<tr>
<th>TID</th>
<th>Score</th>
<th>Frequency</th>
<th>Investment_Size</th>
<th>Recent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.3</td>
<td>3</td>
<td>50000000</td>
<td>-2359</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>5609080</td>
<td>-1258</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>1</td>
<td>100000000</td>
<td>-398</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>140000000</td>
<td>-318</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>32000000</td>
<td>-5</td>
</tr>
</tbody>
</table>
(6) generate final score

(7) rank each technology

<table>
<thead>
<tr>
<th>TID</th>
<th>Score</th>
<th>Frequency</th>
<th>Investment_Size</th>
<th>Recent</th>
<th>N_Score</th>
<th>N_Frequency</th>
<th>N_Investment_Size</th>
<th>N_Recent</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>4.3</td>
<td>3</td>
<td>5000000</td>
<td>-2359</td>
<td>0.0</td>
<td>10.0</td>
<td>2.5</td>
<td>1.0</td>
<td>11.5</td>
</tr>
<tr>
<td>Geothermal</td>
<td>2</td>
<td>3</td>
<td>5609080</td>
<td>-1258</td>
<td>1.0</td>
<td>10.0</td>
<td>3.0</td>
<td>5.2</td>
<td>8.8</td>
</tr>
<tr>
<td>Biofuel</td>
<td>4</td>
<td>1</td>
<td>10000000</td>
<td>-398</td>
<td>8.8</td>
<td>1.0</td>
<td>6.7</td>
<td>8.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Hydrothermal</td>
<td>3</td>
<td>2</td>
<td>14000000</td>
<td>-318</td>
<td>4.9</td>
<td>5.5</td>
<td>10.0</td>
<td>8.8</td>
<td>11.6</td>
</tr>
<tr>
<td>Nuclear</td>
<td>2</td>
<td>1</td>
<td>3200000</td>
<td>-5</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>10.0</td>
<td>-7.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hottest Technologies</th>
<th>Rank</th>
<th>Investment Ranking</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>1</td>
<td>Hydrothermal</td>
<td>1</td>
</tr>
<tr>
<td>Hydrothermal</td>
<td>2</td>
<td>Biofuel</td>
<td>2</td>
</tr>
<tr>
<td>Geothermal</td>
<td>3</td>
<td>Geothermal</td>
<td>3</td>
</tr>
<tr>
<td>Biofuel</td>
<td>4</td>
<td>Solar</td>
<td>4</td>
</tr>
<tr>
<td>Nuclear</td>
<td>5</td>
<td>Nuclear</td>
<td>5</td>
</tr>
</tbody>
</table>
(6) generate final score

(7) rank each technology

Overall Scores

- Solar: 21.5
- Geothermal: 8.8
- Biofuel: 8
- Hydrothermal: 11.6
- Nuclear: 0

QUERY 2: Tracking Important Technologies
IDENTIFYING KEY FACTORS IN PROJECT PROFITABILITY

(1) retrieve cash flow, policy score, technology score, and GDP

(2) multilinear regression analysis

(3) graphical representation in MATLAB
(1) retrieve cash flow, policy score, technology score, and GDP

Calculating Average Policy Score

```
SELECT IHC.IID, P.PollID, (Avg(SL.Score)+Count(SL.RID)) AS PolicyScore
GROUP BY P.PollID, IHC.IID;
```

```
SELECT A.IID, avg(A.PolicyScore) AS AVGPolicyScore
FROM Query2_Policy AS A
GROUP BY A.IID;
```

Retrieving GDP

```
SELECT IHC.IID, C.GDP
FROM Investment_Has_Country AS IHC, Country AS C
WHERE IHC.Country_Code=C.Country_Code;
```

Retrieving Tech Score

```
SELECT IIT.IID, Q2.score
FROM Investment_Involves_Technology AS IIT, Query2 AS Q2
WHERE IIT.TID=Q2.TID;
```

Exporting Cash Flow, Tech Score, Policy Score, GDP

```
SELECT DISTINCT Query3_Final.IID, Cash_Flow.Amount, Query3_AVGPolicyScore.*, Query3_Final.GDP, Query3_Final.TechScore
FROM Query3_AVGPolicyScore INNER JOIN (Cash_Flow INNER JOIN Query3_Final ON Cash_Flow.IID = Query3_Final.IID) ON Query3_AVGPolicyScore.IID = Query3_Final.IID
WHERE Cash_Flow.CFYear=2014;
```
(1) retrieve cash flow, policy score, technology score, and GDP

<table>
<thead>
<tr>
<th>IID</th>
<th>CashFlow</th>
<th>PolyScore</th>
<th>TechScore</th>
<th>GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3859399</td>
<td>8</td>
<td>2</td>
<td>29809</td>
</tr>
<tr>
<td>1</td>
<td>8395739</td>
<td>6</td>
<td>3</td>
<td>39</td>
</tr>
<tr>
<td>2</td>
<td>3847593</td>
<td>1</td>
<td>3</td>
<td>3880</td>
</tr>
<tr>
<td>3</td>
<td>7389508</td>
<td>2</td>
<td>6</td>
<td>12999</td>
</tr>
<tr>
<td>4</td>
<td>55000139</td>
<td>4</td>
<td>4</td>
<td>5927</td>
</tr>
<tr>
<td>5</td>
<td>23000000</td>
<td>3</td>
<td>2</td>
<td>8471</td>
</tr>
<tr>
<td>6</td>
<td>32188882</td>
<td>9</td>
<td>8</td>
<td>284</td>
</tr>
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<td>7</td>
<td>348759</td>
<td>7</td>
<td>5</td>
<td>27</td>
</tr>
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<td>284749</td>
<td>3</td>
<td>8</td>
<td>8765</td>
</tr>
<tr>
<td>9</td>
<td>385639</td>
<td>4</td>
<td>7</td>
<td>387</td>
</tr>
<tr>
<td>10</td>
<td>4847590</td>
<td>4</td>
<td>2</td>
<td>39</td>
</tr>
</tbody>
</table>
**QUERY 3:** Identifying Key Factors in Project Profitability

(2) **multilinear regression analysis**

\[ \text{CashFlow} = a \times \text{PolyScore} + b \times \text{TechScore} + c \times \text{GDP} + k \]

<table>
<thead>
<tr>
<th>Linear Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regression Statistics</strong></td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>R Square</td>
</tr>
<tr>
<td>Adjusted R Square</td>
</tr>
<tr>
<td>Standard Error</td>
</tr>
<tr>
<td>Total Number Of Cases</td>
</tr>
</tbody>
</table>

\[ \text{CashFlow} = 5.5597\times \text{PolyScore} + 2.8325\times \text{TechScore} + 0.2396\times \text{GDP} - 65199 \]

<table>
<thead>
<tr>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>d.f.</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Regression</td>
</tr>
<tr>
<td>Residual</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
**QUERY 3: Identifying Key Factors in Project Profitability**

(2) **multilinear regression analysis**

\[ \text{CashFlow} = a \times \text{PolyScore} + b \times \text{TechScore} + c \times \text{GDP} + k \]

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>LCL</th>
<th>UCL</th>
<th>t Stat</th>
<th>p-level</th>
<th>H0 (5%) rejected?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-6.52</td>
<td>21.</td>
<td>-47.32</td>
<td>-0.31</td>
<td>0.77</td>
<td>No</td>
</tr>
<tr>
<td>PolyScore</td>
<td>5.56</td>
<td>3.87</td>
<td>-1.96</td>
<td>1.44</td>
<td>0.2</td>
<td>No</td>
</tr>
<tr>
<td>TechScore</td>
<td>-2.83</td>
<td>3.06</td>
<td>-8.78</td>
<td>-0.92</td>
<td>0.39</td>
<td>No</td>
</tr>
<tr>
<td>GDP</td>
<td>0.24</td>
<td>0.19</td>
<td>-0.13</td>
<td>1.27</td>
<td>0.25</td>
<td>No</td>
</tr>
</tbody>
</table>

\( T (10\%) \) = 1.94

**LCL** - Lower value of a reliable interval (LCL)

**UCL** - Upper value of a reliable interval (UCL)
QUERY 3: Identifying Key Factors in Project Profitability

CashFlow = a*PolyScore + b*TechScore + c*GDP + k
ANALYZING POLICY EFFECTS ON PROJECTS

(1) extract cash flow and cost of capital of comparable project over past years

(2) perform sensitivity analysis

(3) predict difference in IRR

(4) import into access as attribute of policy
(1) extract cash flow and cost of capital of comparable project over past years

```sql
SELECT
    DISTINCT inv.Amount AS Initial_Investment,
    CF.CFyear,
    o.Tax_Expense,
    o.Operating_Cost,
    o.Interest_Expense,
    i.Total_inflow,
    p.Tax_Impact
FROM
    Outflow AS o,
    Inflow AS i,
    Policy AS p,
    Country AS c,
    Cash_Flow AS CF,
    Investment AS inv,
    Investment_Has_Country AS ihc
WHERE
```
(1) extract cash flow and cost of capital of comparable project over past years

<table>
<thead>
<tr>
<th>Initial_Invest</th>
<th>CFyear</th>
<th>Tax_Expense</th>
<th>Operating_C</th>
<th>Interest_Exp</th>
<th>Total_inflow</th>
<th>Tax_Impact</th>
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</thead>
<tbody>
<tr>
<td>500000</td>
<td>2009</td>
<td>60000</td>
<td>10000</td>
<td>50000</td>
<td>480000</td>
<td>-10.00%</td>
</tr>
<tr>
<td>500000</td>
<td>2010</td>
<td>5000</td>
<td>5000</td>
<td>2000</td>
<td>30000</td>
<td>-10.00%</td>
</tr>
<tr>
<td>500000</td>
<td>2011</td>
<td>33000</td>
<td>50000</td>
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<td>200000</td>
<td>-10.00%</td>
</tr>
<tr>
<td>500000</td>
<td>2012</td>
<td>35000</td>
<td>300000</td>
<td>80000</td>
<td>540000</td>
<td>-10.00%</td>
</tr>
<tr>
<td>500000</td>
<td>2013</td>
<td>50000</td>
<td>100000</td>
<td>10000</td>
<td>400000</td>
<td>-10.00%</td>
</tr>
</tbody>
</table>
(2) perform sensitivity analysis
(3) predict difference in IRR

### Analysis of Tax Policy Effects

<table>
<thead>
<tr>
<th>Year</th>
<th>Total inflow</th>
<th>Operating costs</th>
<th>Interest expense</th>
<th>Cash flow before tax</th>
<th>Original tax expense</th>
<th>Original tax rate</th>
<th>Original net cash flow</th>
<th>Internal Rate of Return</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
<td>2010</td>
<td>2011</td>
<td>2012</td>
<td>2013</td>
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<tr>
<td></td>
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<td>50000</td>
<td>30000</td>
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<td>20000</td>
<td>100000</td>
<td>80000</td>
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<td>5000</td>
<td>33000</td>
<td>35000</td>
<td>50000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14.29%</td>
<td>21.74%</td>
<td>23.57%</td>
<td>21.88%</td>
<td>17.24%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-500000</td>
<td>360000</td>
<td>180000</td>
<td>107000</td>
<td>125000</td>
<td>240000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### After Policy:

<table>
<thead>
<tr>
<th>Policy impact on tax</th>
<th>Tax rate after policy</th>
<th>Tax expense after policy</th>
<th>Net cash flow after policy</th>
<th>IRR after policy</th>
<th>Difference in IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10%</td>
<td>12.86%</td>
<td>54000</td>
<td>366000</td>
<td>24.33%</td>
<td>1.12%</td>
</tr>
<tr>
<td>-9%</td>
<td>13.00%</td>
<td>54600</td>
<td>365400</td>
<td>24.22%</td>
<td>1.01%</td>
</tr>
<tr>
<td>-11%</td>
<td>12.71%</td>
<td>53400</td>
<td>366600</td>
<td>24.44%</td>
<td>1.23%</td>
</tr>
</tbody>
</table>
IDENTIFYING PROMISING REGIONS

(1) define pscore
(2) evaluate region by investment potential
(3) visualize results by plotting pscore on a heat map
(1) identify pscore

\[ P_{score} = (Electricity\ cost\ per\ kWh) \times [(\#\ of\ investments) + (\#\ of\ research\ articles)] \]

- Higher electricity cost → more demand for sustainable energy
- More investments → higher level of activity, more potential investors
- Another indicator of activity
(2) evaluate region by investment potential

**Investment Potential** = \( \frac{2014_{Pscore}}{2013_{Pscore}} + (\# \text{ of possible investors}) \)

- Increasing trend of activity?
- Can projects be readily funded?
(2) evaluate region by investment potential

```sql
SELECT rgn.NName, A.PScore/B.PScore + C.NumberInvestors AS InvestmentPotential
FROM (
(SELECT rgn.RgnID, rgn.Electricity_Cost_Per_kWh * (COUNT(i.IID) + COUNT(r.RID)) AS PScore FROM Investment AS i, Research AS r, Region AS rgn, Country AS cs, Country_Relates_to_Research AS crr WHERE YEAR(r.Article_Date) = '2014' AND crr.RID = r.RID AND crr.Country_Code = cs.Country_Code AND cs.Part_of_RegionID = rgn.RgnID AND r.Article_Date <= Date() AND r.Article_Date >= DateAdd("d", -30, Date()) GROUP BY rgn.RgnID, rgn.NName, rgn.Electricity_Cost_Per_kWh) AS A,

(SELECT rgn.RgnID, rgn.Electricity_Cost_Per_kWh * (COUNT(i.IID) + COUNT(r.RID)) AS PScore FROM Investment AS i, Research AS r, Region AS rgn, Country AS cs, Country_Relates_to_Research AS crr WHERE YEAR(r.Article_Date) = '2013' AND crr.RID = r.RID AND crr.Country_Code = cs.Country_Code AND cs.Part_of_RegionID = rgn.RgnID AND r.Article_Date <= Date() AND r.Article_Date >= DateAdd("yyyy", -1, Date()) GROUP BY rgn.RgnID, rgn.NName, rgn.Electricity_Cost_Per_kWh) AS B,

(SELECT r.RgnID, COUNT(pr.SSN) AS NumberInvestors FROM Region AS r, Person_Lives_In_Region AS pr, Company AS c, Private_Investor AS pi WHERE pr.RgnID = r.RgnID AND pr.SSN = pi.SSN AND c.RgnID = r.RgnID GROUP BY r.RgnID, r.NName) AS C,

Region rgn
WHERE A.RgnID = B.RgnID AND rgn.RgnID = A.RgnID AND C.RgnID = A.RgnID
GROUP BY A.PScore, B.PScore, rgn.NName, C.NumberInvestors;
```
(3) visualize results by plotting investment potential on a heat map
EXTRA FEATURES

- form-based entry
- password-protected financial data
issue

Each research tuple requires data related to 10 tables:
- “Research” table
- 5 related tables (other entities)
- 4 joining tables (relationships)

solution

Use two queries to produce a subform capable of updating the related and join tables
DATA UTILITY: FORM-BASED ENTRY

QUERY 1: Provide Subform With Appropriate Linking Data to the Research Article being entered

```sql
SELECT Research_Relates_To_Industry.RID, Research_Relates_To_Industry.IndID, Industry.IName
FROM Industry INNER JOIN (Research INNER JOIN Research_Relates_To_Industry ON Research.RID = Research_Relates_To_Industry.RID) ON Industry.IndID = Research_Relates_To_Industry.IndID;
```

QUERY 2: Populate Dropdown Menu

```sql
SELECT Industry.IndID, Industry.IName
FROM Industry;
```
DATA UTILITY: FORM-BASED ENTRY

[Image of a form-based data entry system]

**Research**

- **RID (Auto Updates)**: 2
- **URL**: google.com
- **Summary**: Article summary text
- **Comments**: Article comments

**Assign Significance Level**

Note: Employees who do not rate the significance of the article as it is added to the database can assign significance levels in the Significance_Level table.

<table>
<thead>
<tr>
<th>SSN</th>
<th>Score</th>
<th>Date of Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>2348932</td>
<td>2</td>
<td>11/29/2014</td>
</tr>
</tbody>
</table>

**Research Relates To Industry2**

- **IName**: Energy

**Technology Relates To Research3**

- **TName**: Technology2, Technology3

**Policy Relates To Research**

- **Impact**: 10
- **PolID**: 1

Finished? Press the right arrow BELOW this text to go to the next research entry form.
PASSWORD-PROTECTED FINANCIAL DATA
NORMALIZATION ANALYSIS
DECOMPOSING TO 1NF

Country (Country_Code, Name, Govt_Type, Area, GDP, Part_of_RegionID, Population, GDP_Per_Capita, Primary_Energy_Source, President, Interest_Level, State)

Research (RID, Summary, Comment, Date)

multivalued attributes

Country (Country_Code, Name, Govt_Type, Area, GDP, Part_of_RegionID, Population, GDP_Per_Capita, Primary_Energy_Source, President, Interest_Level)

Research (RID, Summary, Date)
Research_Comments (RID, Comment)
DECOMPOSING TO 2NF

Country_Has_Policy (Country_Code, PolicyID, Discount_Rate, CountryName)

attribute(s) not fully dependent on composite key

Country_Has_Policy (Country_Code, PolicyID, Discount_Rate)
DECOMPOSING TO 3NF

Country (Country_Code, Name, Govt_Type, Area, GDP, RgnID\(^1\), Population, GDP_Per_Capita, Primary_Energy_Source, President, Interest_Level)

Country (Country_Code, Name, Govt_Type, Area, GDP, Part_of_RegionID\(^1\), Population, Primary_Energy_Source, President, Interest_Level)

GDP_Per_Capita.Values (Country_Code, GDP_Per_Capita)
DECOMPOSING TO BCNF

Allotrope_Employee (SSN, Location, Login)

Assumption: One person can work in multiple locations

<table>
<thead>
<tr>
<th>SSN</th>
<th>Location</th>
<th>Login</th>
</tr>
</thead>
<tbody>
<tr>
<td>123456789</td>
<td>San Francisco</td>
<td>Bob</td>
</tr>
<tr>
<td>123456789</td>
<td>Los Angeles</td>
<td>Bob</td>
</tr>
<tr>
<td>234567890</td>
<td>San Francisco</td>
<td>Ethan</td>
</tr>
<tr>
<td>345678901</td>
<td>Jakarta</td>
<td>Philip</td>
</tr>
</tbody>
</table>

Allotrope_Employee (SSN, Location)
Login (Login, Location)
Many thanks to . . .

Bob Hambrecht
Ethan Ravage
Ken Goldberg
Animesh Garg
MANY THANKS TO...

Bob Hambrecht
Ethan Ravage
Ken Goldberg
Animesh Garg