

Teaching Case

Enhancing Knowledge Integration: An Information System Capstone Project

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ABSTRACT

This database project focuses on learning through knowledge integration; i.e., sharing and applying specialized (database) knowledge within a group, and combining it with other business knowledge to create new knowledge. Specifically, the Tiny Tots, Inc. project described below requires students to design, build, and instantiate a database system for a hypothetical national retail marketing chain. The project also requires the students to test, via queries, several profit improvement hypotheses and, based on their analysis of query results, propose a set of recommendations for improving profits at Tiny Tots. Designing, instantiating, and using a database provides a learning opportunity for students to integrate the basic database techniques (entity-relation diagrams, normalization, scripting, joins, etc.) into a sensible whole and, through teamwork, to diffuse that knowledge throughout the group. Proposing, documenting, and defending their profit improvement recommendations encourages students to integrate their database knowledge with that learned in marketing (price elasticity and supply chain management), accounting (cost accounting and income statement analysis), management (personnel evaluation and compensation analysis), finance (capital budgeting and credit card analysis), and operations management (fraud detection and working capital control). Such knowledge integration is critical to graduating IS students since they will be expected to apply their specialized knowledge to a wide variety of business problems. This project is most suitable in an information systems capstone course or a graduate level database course.

Keywords: Database, Knowledge Integration, Capstone Project, Profit Improvement

1. PROJECT SUMMARY

Tiny Tots, Inc. (TTI) is a hypothetical retail marketing chain selling the latest fashions in children's clothing. To help executives evaluate and manage its 16 stores, TTI has requested your consulting team to design and build a relational database system that summarizes weekly sales for each product (style) by salesperson. Once the database has been developed and instantiated with four weeks of test data (provided by TTI accountants), management has requested your team to use the test data in addressing 15 questions (queries) concerning potential problem areas at TTI. Finally, management would like your team to generate a set of profit improvement recommendations based on your analysis of query results and "best practices".

2. PROJECT BACKGROUND AND REQUIREMENTS

TTI has been experiencing rapid growth and plans to double in size and profits within the next three years. Currently TTI

operates 16 stores, all of which have been in operation for eight years or more. They are located in four different regions, with each region covering one or more states; each state is in one and only one region. Each store is staffed with three salespeople and a store manager. A salesperson is typically 18-24 years old, a high school graduate, has at least three months of retail experience, and is usually paid a base salary plus a sales commission. A manager is at least 22 years old, a high school graduate, and has at least four years of retail experience. Each manager is paid a base salary (\$30,000) and a sales commission of 2% of his/her store's total gross revenue. A manager's responsibilities include hiring and firing salespeople, setting and changing all (weekly) retail prices at his/her store for every product (style), reporting weekly sales to the corporate office, and ordering products from vendors to replenish store inventories.

The system must be designed to satisfy several requirements as described below. (Note: the attribute formats are given in parenthesis within the text below; e.g., D4

indicates a four digit numeric field, C5 indicates a five character alphanumeric field.)

2.1 Store Information

For each of its stores, TTI keeps track of the store's ID (C2), name (C15), state (C2), size in square feet (D4), region code (C2) and region name (C9), monthly rent (D5), the historical percentage of sales that are paid by credit card (D3). TTI also stores the IDs (C2), names (C20), base salaries (D5), commission percentages (D2) and titles (C3) of all the salespeople and managers working at the store. Each employee can work at only one of TTI's stores.

In addition, TTI keeps track of the store type (C2) and description of the store type (C12); e.g., "mall store", "strip center store", etc. For each type of store, TTI wants to track the average store size (in square feet), and the average rent. Finally, for each region, TTI wants to track the number of stores in the region, and the total profit for the region (for the latest year, quarter and week).

2.2 Style Information

For each piece of clothing that TTI sells in its stores, TTI keeps track of the style number (C6) and description (C20); the ID (C3), name (C10) and address (C15) of the vendor that supplies the style to TTI; and the per unit cost of the style which is the same for all stores. In addition, each style of clothing is assigned to a specific department; a department has a department code (C2), a department name (C12), and the number of different styles sold in the department (D2). TTI also needs each style's mark-up (D5,2), calculated by the following formula: average monthly retail price for this style at this store minus vendor's cost for this style, dividing the result by the vendor's cost. Each style is supplied by only one vendor, but a vendor may supply several different styles. Each store does not necessarily sell every style – regional differences dictate different stores sell different product mixes.

2.3 Sales Information

Each week (D2) in each year (D4), TTI summarizes the sales by style, salesperson ID and week; i.e., TTI records the retail price (D4,2), and the number of units sold (D4) by each salesperson for each style of clothing during each week in each year, the total dollar sales generated (D7,2) by each salesperson, and the total commission TTI paid on those sales (D6,2). Note that TTI changes retail prices at most once each week, and such changes, if they occur, are always made on Monday mornings before opening the store; i.e., each style has one and only one price for a given week in a given store. Note also that any salesperson can sell any style in any department within the store s/he works.

2.4 Inventory Information

TTI recently began tracking inventories at each store. After close of business on the last business day of each month, the store manager reports the number of units (physical count) on hand (D4) for each style at his/her store; this becomes the beginning inventory for the next month. TTI also calculates the months-demand-in-inventory (D5,1) for each style at each store.

2.5 First Deliverable

Your first assignment in this project is to generate a set of tables and attributes for the database, including for each proposed table, the table name, a list of attributes along with their formats, the primary key attribute(s) (underlined), any foreign key(s) along with the table(s) referenced, and a sample tuple (make up some data in the appropriate format). Note that TTI management is not interested in the normalization process, just the results.

3. TINY TOTS REQUIRED INFORMATION

To aid in the building and testing of the TTI database, management has requested the corporate accountants to provide you with four weeks of "representative weekly sales data"; i.e., weekly sales for each style number sold by each salesperson at each store (you can assume that this same four weeks of data is replicated 13 times throughout the year). Further, to aid in the analysis of this data, the Executive Committee has generated a list of "profit segmentation" questions (queries) that should be of interest in improving profits and determining where to "grow the business". The following assumptions, calculations and hints gleaned from extensive interviews with key TTI personnel are germane to this profit segmentation study.

3.1 Variable Cost Calculations

The corporate cost of capital at TTI is 1% per month; this is used in the inventory holding cost calculated below. In calculating net income, gross revenue is simply the number of units sold times the retail price. There are four components of variable costs: 1) the cost of goods sold (COGS), calculated as the number of units of a style sold multiplied by the style's vendor cost, 2) the total commission calculated as the salesperson's percent commission plus 2% (the manager's commission) multiplied by the gross revenue and divided by 100 (to convert percents to a decimal equivalent), 3) the credit card costs calculated as the average percent credit card sales at the store (divided by 100 to convert it to a decimal equivalent) multiplied by the total store gross revenue multiplied by 0.03 (the credit card processing fee), 4) the unit-inventory-holding-cost (IHC) calculated by first computing the total units sold (four weeks) for each style at each store and using it as the average monthly demand, then calculating the unit IHC for each style by dividing the inventory on hand of that style at that store by the average monthly demand of that style, and multiplying the results by the vendor's cost of that style, and finally multiplying the results by 0.01 (the monthly cost of capital at TTI); for a given week, unit-inventory-holding-cost must be multiplied by the number of units sold, giving the weekly inventory holding cost for the style at that store.

3.2 Fixed Cost Calculations

Fixed costs, consisting of monthly rent and annual salaries, should be included when calculating net income at the store, region, and company level, but should be omitted when calculating variable cost coverage (VCC) at the department, style and salesperson levels. Note that all salespeople do not earn \$10,000/year – several earn \$25,000/year. To calculate the annual total salaries, sum the base salaries for the three

salespersons that work at each store and add the store manager's salary of \$30,000/year.

3.3 Hints for Calculating TTI Profits

The following are some (hopefully) helpful hints in calculating profits. When calculating profits at TTI, build a view, named TTIProfits, that has all the attributes in the Sale table plus one attribute for each of the following: store ID, gross revenue, cost of goods sold, commission (salesperson's and manager's), credit card costs, inventory holding costs, and variable cost coverage (VCC) (= gross revenue less all variable costs). You can do this in one view or you can break it into smaller views (one for each type of expense) and then combine them into one view; if you use smaller views, make sure that each smaller view includes the week number, style number, and salesperson's ID, so that you can join them correctly later on.

When joining the Inventory-on-Hand table with the Sale table, you'll have to use **two join conditions**, since there is a composite key (store ID, style number) for the former and also a composite key (week number, style number, salesperson ID) for the later (in the Sale table, the salesperson's ID can be used to get the store ID by joining it with the Salesperson table). Remember that whenever there are entirely too many rows in a joined table, there is probably an error in the join condition(s).

3.4 Second Deliverable

Your second deliverable is to load the data from the attached script file provided by your instructor (Teaching Notes, Section 1). Use this test data to generate the appropriate responses to the Executive Committee's fifteen questions (see Teaching Case, Appendix 1). Specifically, for each question, list (and clearly label with the appropriate query number) the **final query results only**. As an appendix to your results, list (and clearly label with the appropriate query number) the views and queries that were used to generate the final query results.

TTI accountants have laboriously calculated, and provided, some numbers that you can use to check your output. These check-sums are provided after most queries and usually consist of the first few rows of the output you should expect to get. For those queries without check-sums, you'll need to do some manual checking (or write some creative queries) to validate your results. Unless otherwise specified in the query, round all dollar amounts to the nearest penny, and all percentages to the nearest tenth of a percent. Also, fill in the blanks provided in Appendix 1 – Executive Committee Questions, and hand in Appendix 1 pages as the cover sheets to your second deliverable packet. That is, each team should hand in one copy of Appendix 1 with blanks filled in, one set of final query outputs, and one appendix of views.

Note: when calculating store-level net incomes and including them in the store/regional/company-wide summaries, include the fixed costs of store salaries and store rent. On the other hand, when aggregating data at the style, department or salesperson level, include only variable costs, omitting the problems inherent in allocating fixed cost below the store level.

4. PROFIT IMPROVEMENT RECOMMENDATIONS

Tiny Tots' CEO, Cheryl Sharpe, recently read an article expressing the benefits of a database technology called "hypothesis-driven data mining", which is the process of extracting and validating previously unknown (but hypothesized) actionable information from large databases and data warehouses, and using that information to make crucial business decisions. The CEO is interested in the possibilities of applying this technique to the new TTI database once it has been created and thoroughly tested.

4.1 TTI Profit Improvement

Therefore, Ms. Sharpe would like your consulting team to generate several recommendations for profit improvement and market expansion at TTI. Your recommendations should be based on the results of the Executive Committee's queries (Appendix 1), your analysis of other TTI data, and your discussions with the Executive Committee members and other knowledgeable company personnel.

4.2 Capital Expansion Plans

As mentioned earlier, TTI plans to double its profits and sales within the next three years, and top management is interested in your recommendations on these store expansion plans. However, TTI's maximum capital budget for new store expansion for the next three years is \$2,000,000/year, and each new store that is opened costs approximately \$333,333 in capital expenditures for store fixtures, regardless of geographic area or store type. Store closing costs are approximately \$100,000/store. In order to control certain expansion risks, no more than four new stores can be added to any one region in a given year, and no more than four new stores of a given type can be added in a given year. In evaluating various options, average net income in the proposed expansion segment should be the primary decision criteria; e.g., if the average net income for store type X in region Y is the best, then that would be the market segment in which to open new stores (subject to the constraints listed above).

Therefore, as one of your consulting team's recommendations, TTI would like you to include a recommendation concerning what type of new stores should be added, and in what regions those stores should be added.

4.3 Third Deliverable

For your third deliverable, TTI has requested you to "mine" its data for ways to improve the profits. That is, TTI requests that you analyze the results of the Executive Committee questions, and recommend specific ways to improve the overall profits by changing the way TTI does business so as to improve profits in a given segment, by closing any specific under-performing store(s), and/or by adding stores in various regions.

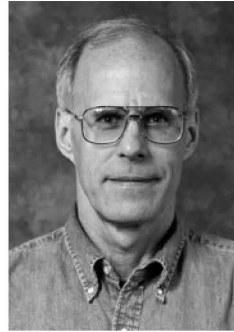
Each recommendation should be specified in a one-page summary that includes the following: 1) a clearly-stated, carefully worded, one sentence statement of the **recommendation** (25 words or less), 2) a theoretical and/or practical **justification** for the recommendation based on financial, accounting, marketing, management, and/or operations management concepts and principles (25 - 50

words), 3) a before-and-after summary table (view) of relevant information that **supports** your recommendation, 4) an estimate of the (preferably) quantitative **benefits** or profit improvements realizable by implementing your recommendation, 5) a list of **assumptions** that you made in calculating the benefits/profits improvements, and 6) a sample **calculation** of how the benefits were derived, if appropriate.

It should be noted that TTI's CEO takes a dim view of consultant recommendations for which there is no firm basis. That is, she requests that the benefits, assumptions and calculations for any recommendation be based on observed facts (i.e., the test data provided), and/or good business sense. Thus, you would be well advised to check with her or one of her vice presidents concerning any critical assumptions/calculations to see if relevant facts/business assumptions are available and/or applicable.

AUTHOR BIOGRAPHY

David M. Steiger is an Associate Professor of Manage-



ment Information Systems at the University of Maine. He received his B.S. in Electrical Engineering and M.B.A. from the University of Texas at Austin and a Ph.D. in Management Science/Information Systems from Oklahoma State University. Between his M.B.A. and Ph.D. degrees, he spent 15 years in various analysis and managerial positions in industry, applying the concepts of information systems and

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APPENDIX 1
Executive Committee Questions

After creating the database and loading the test data, TTI requests that you use the data to generate the appropriate responses to the Executive Committee's fifteen questions (see below). Specifically, for each query, list (and clearly label with the appropriate query number) the **final query output only**. Then, in an appendix, list (and clearly label with the appropriate query number) the views and queries that were used to generate the final output. TTI accountants have laboriously calculated and provided some numbers that you can use to check your output – these check-sums are provided after most queries and usually consist of the first few rows of the output you should expect to get; for those queries without check-sums, you'll need to do some checking on your own to validate your results. Unless otherwise specified in the query, you should round all dollar amounts to the nearest penny, and all percentages to the nearest tenth of a percent. Also, answer any questions below by filling in the blanks provided, and handing in these pages as the cover sheets of your output packet. That is, each team should hand in one answer sheet, one set of final query outputs, and one appendix.

Note that when calculating store-, regional-, or company-level net incomes, you'll need to include the fixed costs of store salaries (provided in the Salesperson table as **annual** salaries) and store rent (provided in the Store table as **monthly** rent).

The Executive Committee Questions are divided into three sets of five queries each (see Roman Numerals at the end of each query), one set for each team member. Please indicate in the blanks below which team member completed which query set:

Query Set I completed by team member: _____.

Query Set II completed by team member: _____.

Query Set III completed by team member: _____.

Hint: Since most of the Executive Questions below deal with variable cost coverage (VCC), we suggest that you create a view, named TTIPROFIT, with all the attributes in the Sale table and additional attributes that compute the revenue, variable costs, and store ID associated with each line of the Sale table. This view can then be used to summarize the VCC and NI as requested in the questions below. The first few rows of this view for store 87 should match the output below.

WEEKNO	STYLENO	SALEID	NUM SOLD	RETAIL	STOREID	REV	COGS	COMM	CC COST	HOLD COST	VCC
3	856128	44	60	16.98	87	1018.8	510	61.13	5.5	4.53	437.64
4	929292	45	150	10.48	87	1572	787.5	220.08	8.49	7.66	548.27
3	929292	44	120	10.48	87	1257.6	630	75.46	6.79	6.13	539.22

- To determine a variation of store incomes throughout the company, for each store, list the store id, store name, total revenue, COGS (i.e., vendor cost), total commissions (including both salesperson and manager commissions), credit card fees, inventory holding cost, total monthly salaries paid, monthly rent, and net income (= VCC - rent - salaries). (TTI pays the credit card companies 3% of all credit card sales, so credit card fees are calculated as the store's total revenue * the store's credit card percent * .03 / 100). Sort your output in descending order by net income. (II)

ID	STNAME	STREV	STCOGS	STCOMM	STCC	STHC	STSAL	RENT	STNI
87	Brickyard	100122	44456	6515	541	764	6250	5100	36497
06	Paramus	89228	38918	9053	1285	661	5000	9300	25012

- Recently, the Executive Committee authorized a test of the price (in)elasticity associated with Wrangler Denim 5-pocket jeans at mall stores; i.e., the price was varied each week in January at several stores to see how sales quantities varied. The Executive Committee wanted to determine where on the price-volume curve the jeans should be priced so as to maximize net income. So, for each **mall store** that sells any style of Denim 5 pocket (jeans) from Wrangler, list the storeid, the style number, the weekno, the retail price (to the nearest penny) charged by that store for Wrangler 5-pocket jeans during that week, the number sold in that week in that store, and the associated gross revenue and net income. Display the information in ascending order by week within the store and style; i.e., ORDER BY STOREID, STYLENO, WEEKNO. Which mall stores sold Wrangler 5 pocket jeans at a different price in each of the 4 weeks? _____, _____. **At store 37**, a) how many units of style 821821 were sold at \$8.98? _____ b) what price resulted in the highest gross revenue? _____ c) what price resulted in the highest net income? _____(II)

STOREID	STYLENO	WEEKNO	RETAIL	NUMSOLD	REV	VCC
02	821821	1	8.98	200	1796	126.15
02	821821	2	10.98	130	1427.4	306.12
02	821821	3	13.98	120	1677.6	592.89
02	821821	4	16.98	110	1867.8	827.94

3. For each salesperson, list the salesperson's id, name, annual base salary, commission percentage, annualized commission (total commission for 4 weeks * 13), and the annualized sales generated by that salesperson. Display the information in order of total sales generated, highest first. Which salespeople worked on salary only; i.e., had no sales commissions? _____ What were the relative rankings (based on total sales) of those salespeople on salary only?

(II)

SALEID	SNAME	SALARY	PC	YRLYCOMM	YRLYREV
38	McDonald Greg	10000	5	31726	634530
27	Jones Elisabeth	10000	9	53659	596211.98
43	Brooks Melanie	25000	0	0	534721.2

4. For each store type within each region, list the region id, type code, and for each store type in that region list the # of stores, total net income, and average net income (= total net income / # stores). Round all numbers to the nearest integer. Sort your results in descending order by average store net income. If you were going to build one new store, what type of store (mall or strip center store) would you build and in which region would you build it? Region: _____ Type _____ What would be your 2nd choice? Region _____ Type _____ (I)

REGION	TYP	NUMSTORES	REGNI	AVGNI
MW	S	3	70078	23359
NE	S	1	23215	23215

5. For each department, list the department id, department name, total net income from all stores in that department, and the percent of the chain's total net incomes represented by that department, rounded to the nearest hundredth of a percent. (II)

DEPTID	DEPTNAME	TOTVCC	PERCENT
00	Infant Boy	135720.47	29.84
10	Infant Girl	140563.33	30.91

6. TTI has 4 product groups that are supplied by different vendors: a) 'Blanket Sleeper' in various colors, 'Stretchy' tights in various colors, 'Denim 5 pocket' jeans sold in various departments, and 'Denim 2 pocket' jeans sold in various departments. For each of these product groups, list the product group ID, style numbers and style descriptions included in the product group, and for each style number, list the vendor name, cost, average retail price (rounded to the nearest penny), total number sold, and total net income. Sort your output alphabetically by style description, and within style description, by vendor name. Hint: One way to do this is to create a view for each product group (G1, G2, etc.), using a literal in the SELECT clause to put in the product group ID, and using a WHERE clause to include all the sales for 'Denim 5 pocket' jeans. So the SQL for denim 5 pocket jeans (with group ID as 'G1' should look something like this:

```
CREATE VIEW Q6ALL (GROUPID,STYLENO,...)AS
SELECT 'G1', STYLENO, ...
FROM ...
WHERE SDESC LIKE 'Denim 5 pocket' ;
```

This will insert the product group ID into every row of the output. Then you can use a UNION to combine all info for all product groups into a single view. (I)

7. Recently, the Executive Committee authorized a test of the price (in)elasticity associated with Wrangler Denim 5-pocket jeans at strip center stores; i.e., the price was varied each week in January at several stores to see how sales quantities varied. The Executive Committee wanted to determine where on the price-volume curve the jeans should be priced so as to maximize net income. So, for each **strip center store** that sells any style of Denim 5 pocket (jeans) from Wrangler, list the storeid, the style number, the weekno, the retail price (to the nearest penny) charged by that store for Wrangler 5-pocket jeans during that week, the number sold in that week in that store, and the associated gross revenue and net income. Display the information in ascending order by week within the store and style; i.e., ORDER BY STOREID,STYLENO,WEEKNO. Which strip center store(s) sold Wrangler 5 pocket jeans at a different price in each of the 4 weeks? _____, _____ **At store 84:** a) how many units of style 821821 were sold? _____ b) what price resulted in the highest gross revenue? _____ c) what price resulted in the highest net income? _____ (I)

STOREID	STYLENO	WEEKNO	RETAIL	NUMSOLD	REV	VCC
81	821821	1	8.98	650	5837	552.57
81	821821	2	10.98	500	5490	1308.46
81	821821	3	13.98	135	1887.3	711.06
81	821821	4	16.98	42	713.16	332.53

8. Drill-Down Queries. a) For each store in Texas, list the store id, store name, total dollar sales, net income and percent of overall corporate net income generated by the store. A store's net income is computed as its total revenues less total variable costs less total fixed costs. List the stores in order from highest to lowest net income. b) For the store with the lowest net income in Texas, list the store id, store name, names and ids and total net income of each department in that store. c) Finally, for the department with the lowest net income in b) above, list the store id, department id, and for each style number sold in that department, list the style number, total # sold, and total net income. (III)

STOREID	DEPTID	STYLE	NUM	STYLEVCC
45	50	979979	1080	-748.86
45	50	942000	720	-538.44

9. For each store, list the store ID, the total value of all beginning inventory on hand at that store (= IOH for a style * cost of that style, summed over all styles sold in that store), the total annual inventory holding cost assuming a 12% cost of capital (= total value of beginning inventory on hand at this store* 0.12), and the average months-demand-in-inventory (= total IOH in a store / total units sold in that store in weeks 1 thru 4). Sort the results by AMDII, highest value first. Hint: To avoid massive double counting of ioh values, first create a view using the Sale table that has the storeid and the total number of units (all products combined) sold at that store (you'll need this total numsold in the AMDII calculation) by joining the Sale table with the Salesperson table to get the Storeid, using a SUM(NUMSOLD) in your SELECT clause, and GROUPING BY STOREID. Your output from this view should be 16 rows long. Then create a second view using the Inventory_on_hand table, the Style table (so you can get the cost), and the view created in 1) above (so you can get the total number of units sold).and calculate what you need based on the formulae provided above. (III)

STOREID	INV_VALUE	ANNUALHOLD COST	AMDII
84	73877.5	8865.3	2.09
89	74622.5	8954.7	1.88

10. For each store, list the store ID, the store name, the % credit card sales, total annual sales that are made (on average) by credit card, and the total annual credit card costs. Note: credit card costs are 3% of credit card sales. Sort your results by storeid. (I)

STORE	LOC	PCCC	YRLYCCSALES	YRLYCC COST
02	Willowbrook	60	675115	20253
06	Paramus	48	556780	16703

11. For each style that is found in inventory but had no sales in January, list the style number, style description, working capital investment (= number-of-units-on-hand company-wide * the vendor cost), and annual inventory holding cost. Sort the results by style number. (II)

12. For each style, list the style number, style description, total units sold (all stores combined), number of units in inventory (all stores combined), and months-demand-in-inventory. Sort the results by MDII, highest value first. (III)

STYLE	SDESC	TOTDEM	IOH	MDII
811234	Denim 5 pocket	1005	2010	2
711111	Denim 2 pocket	1005	2010	2

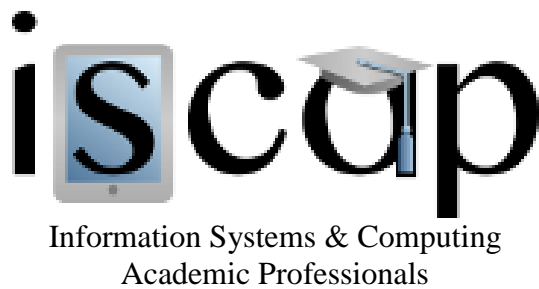
13. For each department (combining all stores), list the total sales (gross revenue), the percent of TII gross revenue generated by that department, the total profit generated by that department and the percent of TII profits generated by that department. Round all percentages to the nearest tenth of a percent. (III)

DEPT	TOTGREV	GREVPC	TOTVCC	VCCPC
00	324581.7	25.9	135720.47	29.8
10	331843.5	26.4	140563.33	30.9

14. For each store manager, list the manager's name, salary, annualized commission, and total compensation (= salary + commission), the store ID where the manager works, and that store's total net annualized income (assuming the first 4 weeks are representative of the rest of the year). Sort the listing in descending order by total compensation. (III)

15. For each region, list the region description, the total number of stores in that region, the total sales, the total net income, and the percent of total corporate net income that region was responsible for (rounded to the nearest tenth of a percent). (I)

REGION	COUNT	TOTREV	REGNI	REGNIPC
MW	4	295967	88669	36.6
NE	4	358645	87498	36.1



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