

# SAS<sup>®</sup> GLOBAL FORUM 2018

## USERS PROGRAM

### From Idea to Implementation: How a SAS Communities Thread Changed How Sleep Number Direct Markets

Aaron Carlson

Sleep Number Corporation

April 8 - 11 | Denver, CO

**#SASGF**



# From Idea to Implementation: How a SAS® Communities Thread Changed How Sleep Number Direct Markets

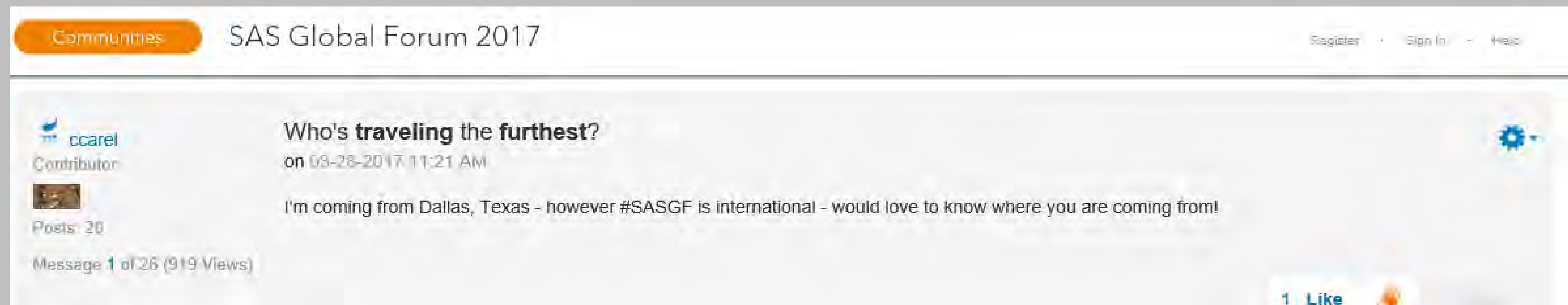
Aaron Carlson

## ABSTRACT

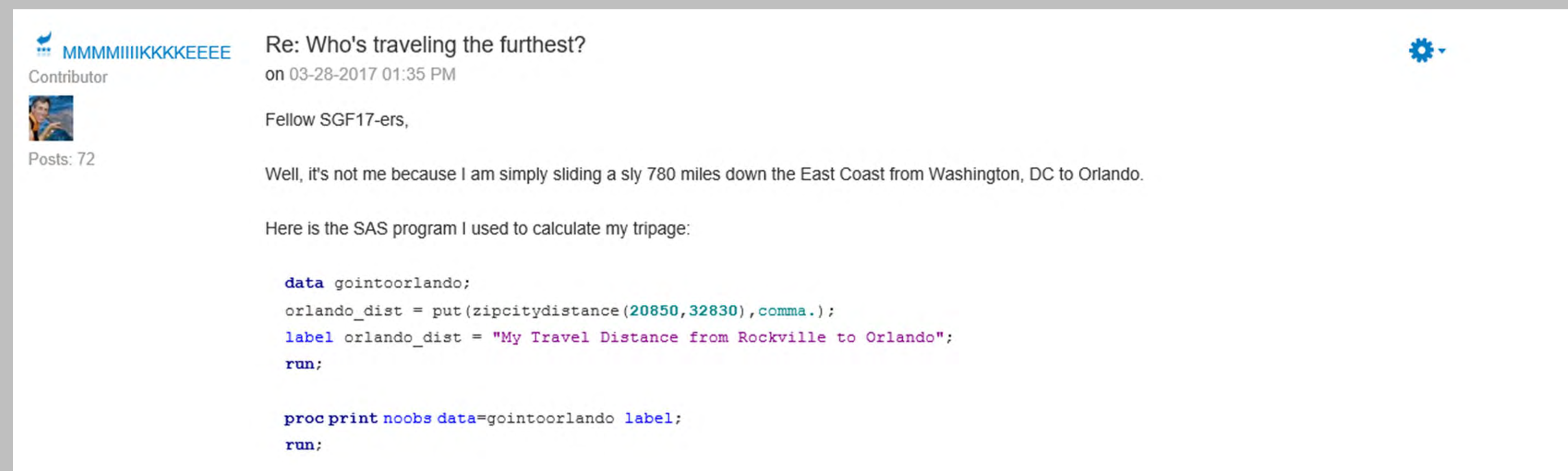
- Born from a 2017 thread regarding who was traveling the furthest for the SAS Global Forum in Orlando, our odyssey began with becoming acquainted with the ZIPCITYDISTANCE function. Calculating distance with SAS was not new to us, but this function was. Previously we had been calculating distance with the Zip code centroid method from code we found on the web! At the Global Forum, we learned of the GEODIST function. We soon found that by using this new calculation we could determine our closest customers with greater accuracy. Now we weren't mistakenly sending offers to people who might be further away. Next, we wanted to know if we could calculate the distance to their closest Sleep Number store for over 15 million people who have purchased or considered the purchase of a Sleep Number bed. We determined that the increased precision of GEODIST could replace certain processes but would entail performing 8.8 billion calculations daily (never an issue for SAS). Through this change, we saw customer's closest store accuracy improve by over 35% and we are measuring customer purchase tendencies from these changes.

## INTRODUCTION

- This story begins here, on Communities.SAS.com, about a year ago on a thread about who was traveling the furthest.
- I was excited to be traveling to Orlando for my fifth SAS Global Forum.
- Little did I know, this post was going to reshape some of the work I would be doing in 2017.



- SAS author Michael Raithel chimed in with a detailed response and some code I had never seen
- It couldn't be this easy, could it? Intrigued, I decided to try it out.





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- I gave it a try and success; though I learned I was not traveling the furthest as others were traveling from Australia and Europe.
- I also was seeing differences in results from the process I was using to calculate results and the value returned from the ZIPCITYDISTANCE formula.
- Talking with experts at the SAS Global Forum helped me understand the differences in the calculations.

- I wasn't unfamiliar with calculating distance using SAS, the process we were using predated my tenure in my current role.
- We were using a version of the Haversine formula that calculates great-circle distance between two points on a sphere.
- This method requires a look up table of zip code centroids longitude and latitude to calculate the distance.
- Like ZIPCITYDISTANCE formula, it returns one distance value regardless of the location within the zip code.



Re: Who's traveling the furthest?

on 03-31-2017 03:58 PM

1,323 for me to travel from the western 'burbs of Minneapolis to Orlando.  
See you all Sunday!

Message 26 of 26 (353 Views)

```
proc sql;
CREATE TABLE Zipcode_&STORE._&RADIUS AS
SELECT
Z.zipcode,
CASE
WHEN Z.latitude EQ S.latitude AND Z.longitude EQ S.longitude THEN 0
ELSE
3963.1*ARCOS(SIN(Z.latitude/57.295775951)*SIN(S.latitude/57.295775951)+COS(Z.latitude/57.295775951)*C
OS(S.latitude/57.295775951)*COS(Z.longitude/57.295775951-S.longitude/57.295775951)) END AS DISTANCE
FORMAT 3.1
FROM Store_Location S, Zipcode_Location Z
WHERE
S.store_number EQ "&STORE"
HAVING
distance LE &RADIUS
ORDER BY
distance,
zipcode;
quit;
```



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## IMPORTANT FUNCTIONS

### Syntax:

```
ZIPCITYDISTANCE(zip-code-1, zip-code-2)
```

### Ex.

```
Distance=zipcitydistance('94103',  
'04401');
```

### Syntax:

```
GEODIST(latitude-1, longitude-1,  
latitude-2, longitude-2 <,options>)
```

### Ex.

```
data _null_;  
  distance=geodist(30.68, -88.25,  
35.43, -82.55);  
  put 'Distance= ' distance  
'kilometers';  
run;
```

SAS writes the following output to the log:

```
Distance= 748.65 kilometers
```

## WHY GEODIST WORKED BETTER FOR OUR NEEDS



The GEODIST function worked better for our process for a couple reasons:

- ZIPCITYDISTANCE measures from the center of the first zip code to the center the second zip code. In the example to the left, the distance from 80004 to 80005 is closer than 80004 to 80403. In this image you can see that our customer's house is closer to the Sleep Number store in 80403 than it is to the Sleep Number store in 80005.
- GEODIST is able to calculate the distance from the house to the store and ultimately benefit the customer by sending offers for the closest store.

ZIPCITYDISTANCE is also dependent on a lookup table to reference zip code centroids. This data can become out of date as zip codes are added, retired or split.

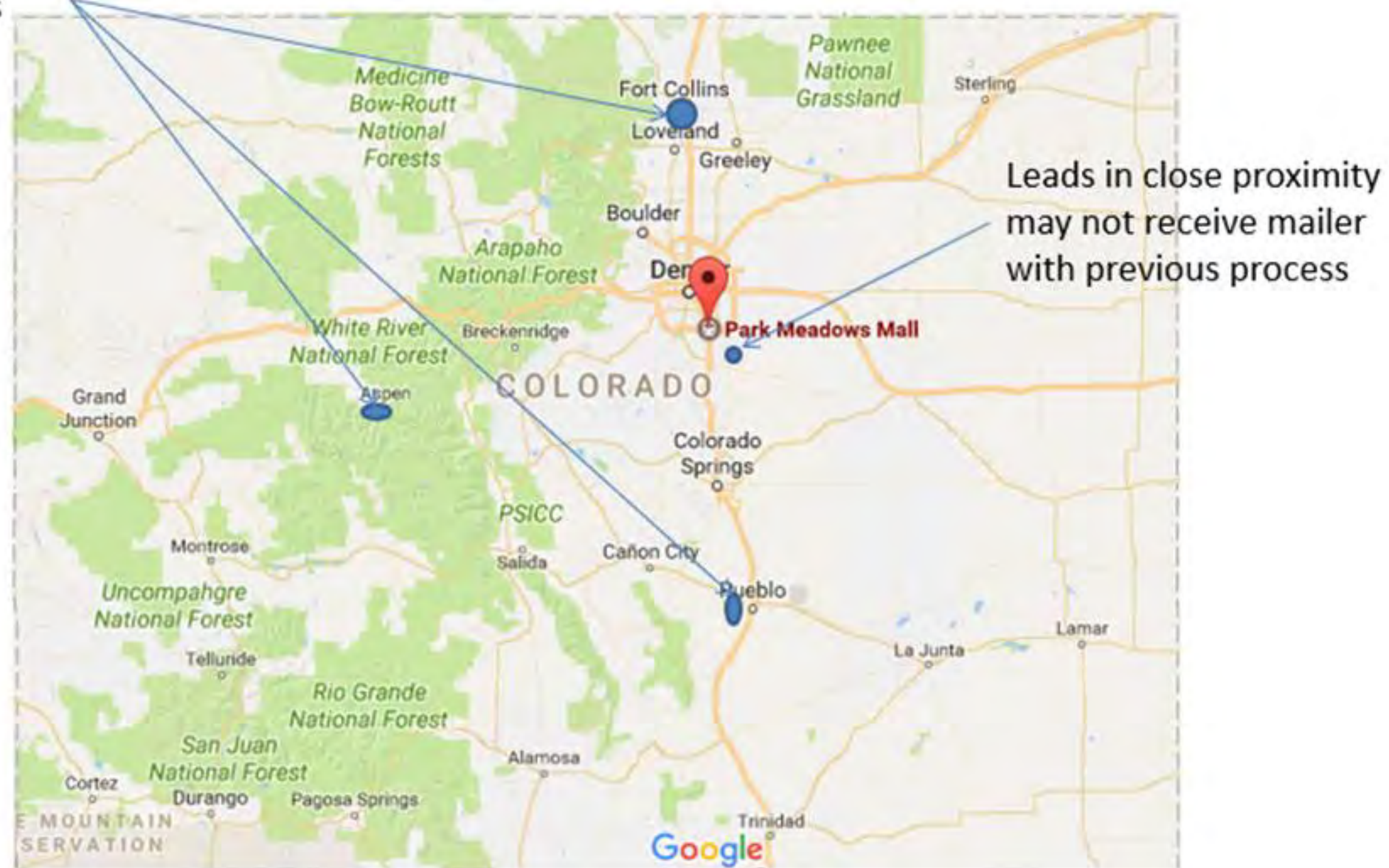


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## GRAND OPENINGS - BEFORE

Leads from as far back as 1994 from Aspen, Fort Collins and Pueblo might receive GO Mailer instead of closer, more current leads

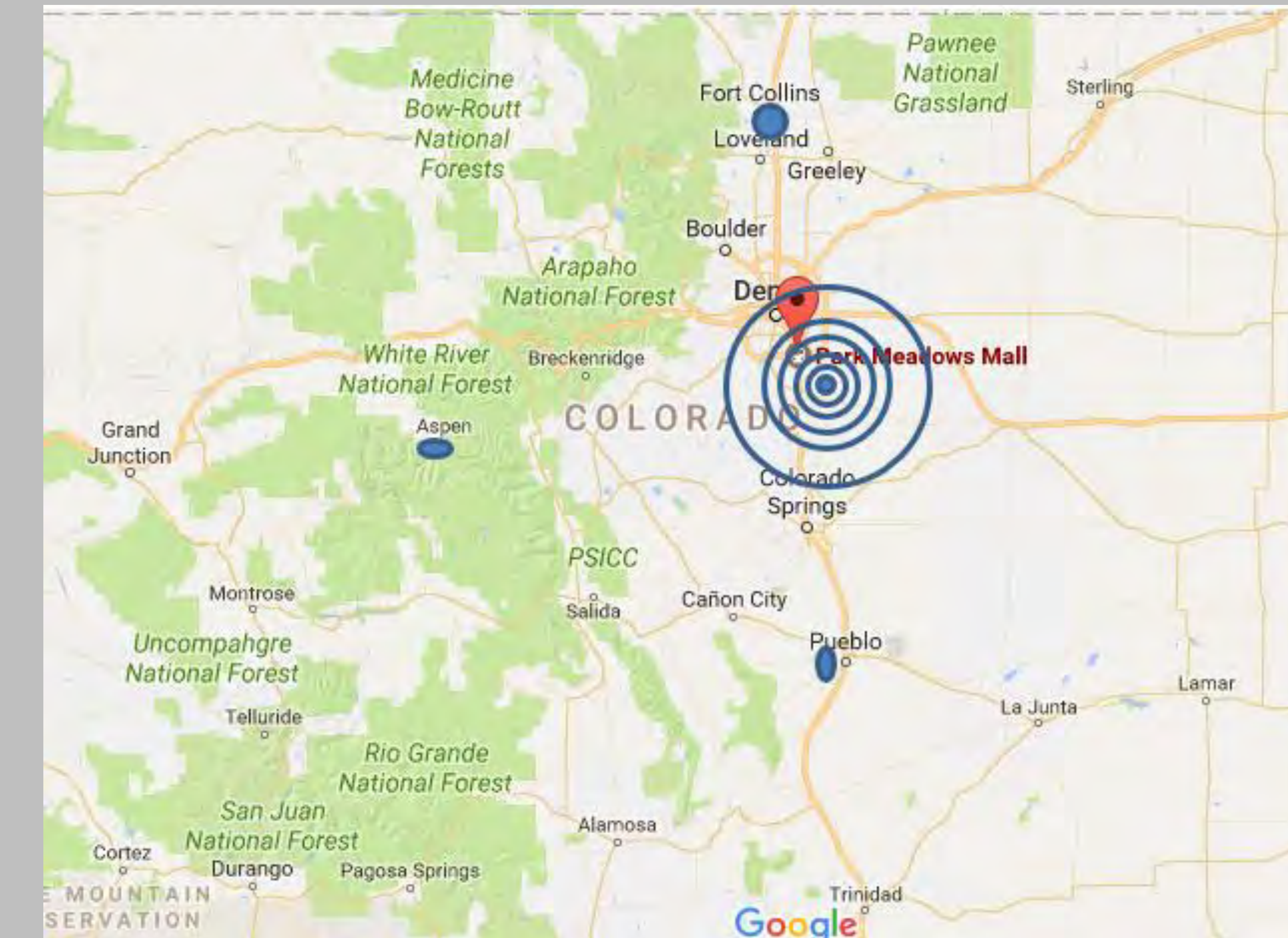


## PROCESSING PRIORITY MATRIX

Inquired within past 1.5 years



## GRAND OPENINGS - AFTER



- Prior to 2017, owners and inquirers who had visited the store would receive offers even if many years had passed since their store visit or purchase.
- Sometime offers were sent to people who did not live within 60 miles of the new store.
- Analysis showed certain segments rarely purchased and others were more likely to purchase.
- We also found distance was also a determinant for purchase.

- In 2017, we implemented a processing priority matrix to ensure the closest, most recent visitors would receive top priority for Grand Opening offers.
- Using the GEODIST function, we calculated distance from store to customer to find who was nearest.
- We also incorporated recency of inquiry or purchase and visit type as factors of potential interest in the offer.
- We went out mile by mile from the Grand Opening location until mail quantity was fulfilled.

- By applying our processing priority matrix and calculating distance with the GEODIST function, we saw amazing results:
  - Bed purchase conversion increased 50%.
  - Sales per mailing increased 65%.
- With this increased conversion, we are currently on track to realize an additional one million dollars in sales in one year's time.



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## CALCULATING CLOSEST STORES

### PROCESS

- Nightly we calculate the three closest stores for all customers and inquiries.
- We match our customer table with our store table using a cartesian join and comparing customer longitude and latitude that is within  $\pm 1.5$  degrees of the store latitude and longitude. This gets us to about 65 miles from the store.
- We retain about 3% of the 8.8 billion calculations, making the process more efficient and manageable.
- Next, we rank the records by distance, to retain the three closest stores.
- Finally we transpose the data to create a single record for each customer with their three closest stores.

### RESULTS

- 11% of all records have a closest store that was different from the previous method.
- 35% of all records have at least one of three closest stores improved.
- 80k records that did not have a closest previously, now have a closest store.
- We are also seeing more people purchase at their closest store.
  - Evaluating a November promotion saw a 5.3% increase of customers purchasing at their closest store over previous year results.
  - Initial indications also appear to show a small increase in overall satisfaction with purchase among those who purchased at their closest store since this change was implemented.

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## CONCLUSIONS

- The seed of change can be found throughout this conference, on a message board, anywhere really.
- Be open to the application of ideas for situations completely different than this.
- These small changes can affect sales, behavior and the environment.
- You may even come away with a million dollar idea.

## CONTACT INFORMATION

Your questions and comments are valued and encouraged  
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## From Idea to Implementation: How a SAS Community Thread Changed How Sleep Number Direct Markets

Aaron Carlson, Sleep Number Corporation

### ABSTRACT

Born from a 2017 thread regarding who was traveling the farthest for SAS® Global Forum in Orlando, our odyssey began with becoming acquainted with the ZIPCITYDISTANCE function. Calculating distance with SAS® was not new to us, but this function was. Previously we had been calculating distance with the ZIP Code centroid method from code we found on the web! At SAS Global Forum, we learned of the GEODIST function. We soon found that by using this new calculation, we could determine our closest customers with greater accuracy. Now we wouldn't mistakenly send offers to people who might be farther away. Next, we wanted to know whether we could calculate the distance to their closest Sleep Number store for over 15 million people who have purchased or considered the purchase of a Sleep Number bed. We determined that the increased precision of GEODIST could replace certain processes but would entail performing 8.8 billion calculations daily (never an issue for SAS). Through this change, we saw customer's closest store accuracy improve by over 35%, and we are measuring customer purchase tendencies from these changes.

### INTRODUCTION

This story begins a little over a year ago. I was getting ready to travel to Orlando for the 2017 SAS Global Forum, my fifth time attending. Each Global Forum has differences, so I wanted to be as prepared as possible. After downloading the conference app, I decided to check in on Communities.SAS.Com and came across a 2017 SAS Global Forum Group. I began to read through the different threads and became interested in who was traveling the farthest. At previous SAS Global Forums, I had met attendees from all around the world. It's common to run into people from Italy, United Kingdom and Curacao. When I read through this thread, I came across some SAS functions for measuring distance that I was not familiar with. Little did I know that this was going to shape a few of the projects I would be working on for the next few months.

### WHERE IT ALL BEGAN

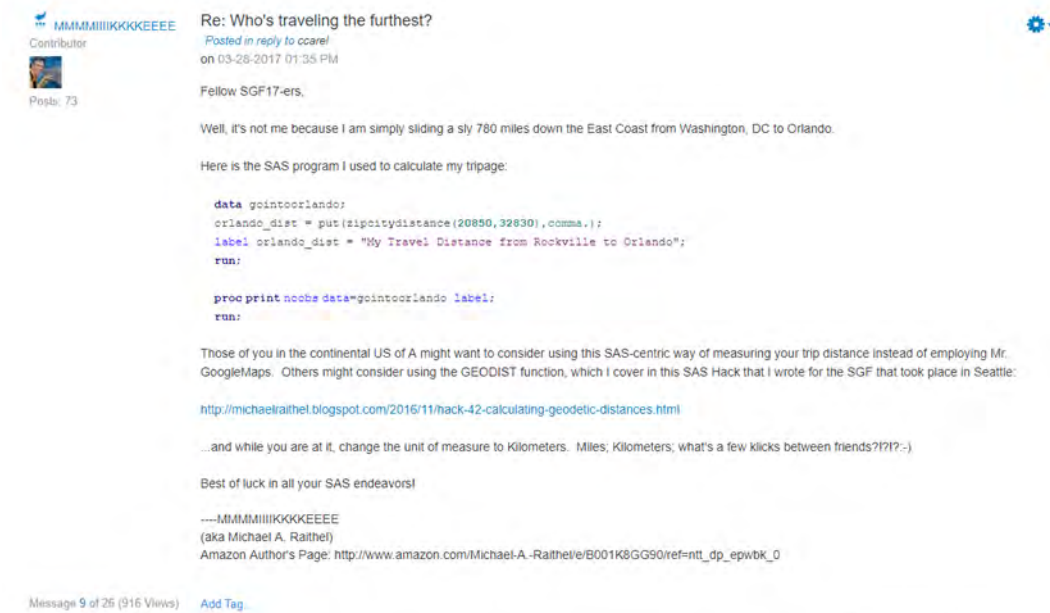
Here is the thread that initially piqued my interest:



Initially people were posting what city they were traveling from. Next, a few chimed in with their city and mileage. I was curious as to how they calculated the distance between their location and the Walt Disney World Orlando, FL. I only had to read down a little further to find out.



SAS author Michael Raithel chimed in and added some code I was unfamiliar with:



The screenshot shows a forum post titled "Re: Who's traveling the furthest?". The author is Michael Raithel, an Amazon Author. The post includes SAS code for calculating the distance from Rockville to Orlando. The code is as follows:

```
data gointoorlando;
  orlando_dist = put(zipcitydistance(20850,32830),comma.);
  label orlando_dist = "My Travel Distance from Rockville to Orlando";
run;

proc print noobs data=gointoorlando label;
run;
```

The post also includes a link to a blog post: <http://michaelraithel.blogspot.com/2016/11/hack-42-calculating-geodetic-distances.html>

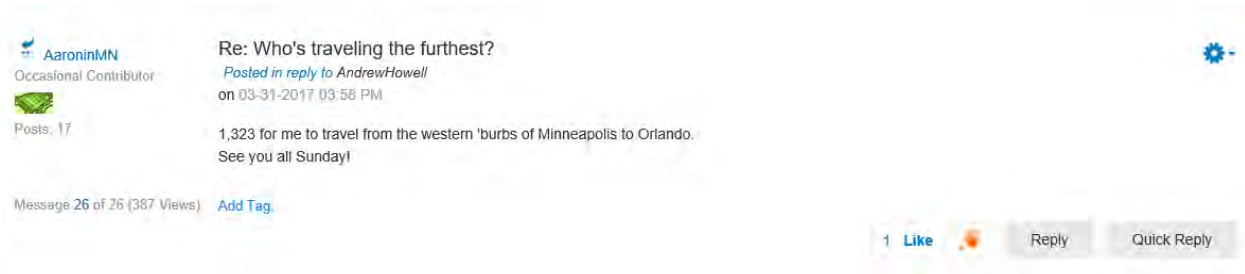
I opened a session in SAS Enterprise Guide and tried his code into a new program. I modified the ZIP Codes from his to my own and voila! SAS calculated the distance.

```
data _null_;
  distance=zipcitydistance('55442', '32830');
  put 'Distance from Plymouth, MN, CA, to Dolphin and Swan
Resort, FL: ' distance 4. ' miles';
run;
```

Distance from Plymouth, MN, CA, to Dolphin and Swan Resort, FL: 1323 miles

NOTE: DATA statement used (Total process time):  
real time 0.04 seconds  
cpu time 0.01 seconds

Here's my post showing the results of the first time I ever used the ZIPCITYDISTANCE function.



The screenshot shows a forum post titled "Re: Who's traveling the furthest?". The author is AaroninMN, an Occasional Contributor. The post includes the result of the SAS code: "1,323 for me to travel from the western 'burbs of Minneapolis to Orlando. See you all Sunday!".

I began to think this could have a practical and useful application for the Customer Relationship Management work I perform at Sleep Number.



## ADDITIONAL BACKGROUND

I wasn't completely unfamiliar with calculating distances using SAS functions, as we had been calculating distances using the ZIP Code centroid method. Here is an example of the code we were using:

```
CASE WHEN Z.latitude EQ S.latitude AND Z.longitude EQ S.longitude THEN 0 ELSE
3963.1*ARCOS(SIN(Z.latitude/57.295775951)*SIN(S.latitude/57.295775951)+COS(Z.
latitude/57.295775951)*COS(S.latitude/57.295775951)*COS(Z.longitude/57.295775
951-S.longitude/57.295775951)) END AS DISTANCE FORMAT 3.1
```

When I compared our method for ZIP Code 65201 to ZIP Code 65203, I saw that the above process we had been using calculated 8.6 Miles where ZIPCITYDISTANCE calculated 7 miles. I left for Orlando hoping to connect with an expert to find out which one was more accurate. It was at the conference exposition hall that I met with a SAS expert who explained how the ZIPCITYDISTANCE function made its calculation.

### Syntax:

**ZIPCITYDISTANCE**([zip-code-1](#), [zip-code-2](#))

```
Ex. Distance=zipcitydistance('94103', '04401');
```

The following day, my schedule included attending the E-Poster presentation "Distances: Let SAS Do The Heavy Lifting" Jason O'Day explained how USBank was using Proc GEOCODE and the GEODIST function. This was a great session and it was here I learned the GEODIST function, a SAS function that returns the geodetic distance based on longitude and latitude. I knew our customer database and store database had latitude and longitude information, so the wheels began to turn as to the world of possibilities that may exist.

### Syntax

**GEODIST**(*latitude-1, longitude-1, latitude-2, longitude-2* <*,options*>)

```
data _null_;
  distance=geodist(30.68, -88.25, 35.43, -82.55);
  put 'Distance= ' distance 'kilometers';
run;
```

SAS writes the following output to the log:

```
Distance= 748.65 kilometers
```

After seeing the accuracy that GEODIST offered, I knew this could benefit the work I was doing.



## GETTING STARTED – REEVALUATING STORE GRAND OPENING MARKETING

Upon returning to Minneapolis, I discussed what I learned with my colleagues and how I might be able to apply these learnings to the work we do. I first wanted to evaluate if we could better select recipients for our grand opening mailers. I first evaluated the current state of our Grand Opening (GO)/or relocating store mailer program. Typically, when we open a new Sleep Number store, we will send out offers to current and potential owners who may be interested in visiting the new Sleep Number store and give them a special offer. What I found was that many of the offers were not being sent to people in the closest proximity of the new store that was opening. We were first sending offers to people who had visited the relocating store regardless of how recent (sometimes many years ago) and regardless of how near (it didn't matter as long as they resided in the same state).

Leads from as far back as 1994 from Aspen, Fort Collins and Pueblo might receive GO Mailer instead of closer, more current leads



Through enhancements, we were quickly able to determine which customers were located closest to our Grand Opening store by using the GEODIST function. From there we prioritized which customers we would like to first get the offer. We now use a processing priority matrix based on type of visitor, recency of visit and distance from Grand Opening store to determine selection for Grand Opening offers. By making these changes in May of 2017, we were able to increase bed purchase conversion by 50%, increase sales per mailings by 65%, and are on track to realize \$1 million in additional sales in one year's time.



## CALCULATING THE CLOSEST STORE

The second process I wanted to re-engineer was how we determine our closest stores. On our printed mailers, we typically list the three closest stores for customers. We had also been using a ZIP Code centroid method for this calculation.



Knowing that the GEODIST function offered greater precision for calculating distances, I decided to make a table for all Sleep Number owners and inquiries containing their three closest stores. My first attempt calculated the distance between each customer and every Sleep Number store for over 8.8 billion calculations. It took about two hours to process and miraculously didn't crash our server. I wanted this process to be more efficient, so I began to modify the process. I was able to speed up performance by eliminating some calculations. I knew that someone residing in Oregon would not have Florida store as a closest top three.

Our Closest store file after modifications improved accuracy for one of the three stores for nearly six million people. We also saw more people purchase at their closest store compared to the same promotion in 2016. More analysis needs to be conducted, but initial indications show that customers surveyed who purchased during this promotion expressed higher overall satisfaction than those who purchased at their closest store from the previous year.

## CONCLUSION

The seed of change can be found throughout this conference, on a message board, anywhere really. Be open to the application of ideas for situations completely different than this. These small changes can affect sales, behavior and the environment. You may even come away with a million-dollar idea.

## REFERENCES

O'Day, Jason 2017. "Distances: Let SAS do the Heavy Lifting", SAS Global Forum 2017 Conference Proceedings

Website SAS Communities, Cary, NC. 2017. "Who's Traveling the Furthest" Accessed January 12, 2018. <https://communities.sas.com/t5/SAS-Global-Forum-2017/Who-s-traveling-the-furthest/gpm-p/345022#M305>

SAS.Com, Cary, NC. 2018. "SAS GEODIST Documentation", Accessed March 1, 2018. <http://support.sas.com/documentation/cdl/en/lrdict/64316/HTML/default/viewer.htm#a003113162.htm>



## ACKNOWLEDGMENTS

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## RECOMMENDED READING

- *Base SAS® Procedures Guide*
- *Communities.SAS.Com*

## CONTACT INFORMATION

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