Collaborative Assignment 2

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## Background

SPS retail manufacturing company is interested to find out whether stores are likely to run out of stock for any of its products in the next seven days. Client has two weeks of data for various stores and products available. Client would like a summary of products that will likely run out of stock the following week.

## Recommendation

Based on our analysis and assumptions, we recommend stocking up on the following products because their probability of running out of stock in two days is at least 10%:

Store Product

11218 102307200068666

12105 102307200058776

11407 102307200068666

11609 102307200081310

10571 102307200077072

10571 102307200026812

14963 102307200071282

11218 102307200026812

11015 102307200063734

11609 102310800150260

13047 102307200079832

11015 102307200025078

For a full listing of results, check out the “Full Results” section.

## Data Assumptions

* Demand for each product follows a Poisson distribution.
* All products are always available for delivery to individual stores from distribution center.
* A product spends a day in transit from distribution center to store. When a product is shipped from distribution center, it will be available the next day in store.
* Daily product demand is calculated as previous day’s stock reduced by current day’s stock plus any products in transit.

## Data Discrepancy

* For some stores, product quantity in stock was negative. These stores were excluded from this analysis.
* For some stores, calculated daily demand was negative. A common cause was a sudden jump in stock quantity. This may have resulted from returns or some other reason. These stores will be excluded from this analysis until the cause can be clarified and accounted for. See Data Recommendations section as well.

## Analysis

After preliminary data management process and removing data discrepancies, the resulting dataset includes product quantity in stock and transit for 216 distinct store and product combinations. Check Code Snippet #1 in the appendix.

For each store and product combination, the mean daily demand was calculated using data from the previous two weeks. Individual mean values served as lambda values for Poisson distribution used to simulate demand for the following 7 days. Check Code Snippet #2 in the appendix.

Weekly demand was simulated for N = 10000 iterations. Using these results, we calculated the out of stock probability as the proportion of simulations that end up with 0 products left in stock per day. Check Code Snippet #3 in the appendix as well as the full final result in the “Full Results” section.

4. Based on the data, comment on how realistic the two-day transit assumption is.

## Data Recommendations

Based on using this data, here are some suggestions for the future:

* Determining demand based on the InStock data, as well as InTransit and AtCenter, is unreliable and difficult. This data should instead be gathered from sales records for that day, which would be much more accurate.
* Reasoning for negative stock should be recorded as this may be a result of back orders, clerical error, or other cause. Likewise, the reason for negative demand is unclear and may be a result of same day deliveries (not captured as Transit or AtCenter), product returns, or other. For this analysis, products with either negative stock or demand were excluded but perhaps not appropriately if further information were available.

## Appendix

* Snippet #1: Code to Load Data, Filter Negative InStock Rows: Lines 6 – 21
* Snippet #2: Code to Calculate demand, remove any negative demand: Lines 23 – 52
* Snippet #3: Simulate demand and find probabilities of running out of stock: Lines 83 – 86, 99 - 125

## R Code

Link to the final source code can be found here: <https://github.com/jquacinella/IS606_Collab_2/blob/master/606group2.R>

## Full Results

Here is the full result of store and product combinations and their daily probability of running out, sorted by the probability of running out in one day (descending):

StoreProduct P1 P2 P3 P4 P5 P6 P7

11218 102307200068666 0.9012 0.9904 0.9990 1.0000 1.0000 1.0000 1.0000

12105 102307200058776 0.8504 0.9777 0.9976 0.9997 1.0000 1.0000 1.0000

11407 102307200068666 0.8255 0.9704 0.9945 0.9990 0.9999 0.9999 1.0000

11609 102307200081310 0.7690 0.9473 0.9869 0.9972 0.9994 0.9999 0.9999

10571 102307200077072 0.3222 0.5406 0.6822 0.7806 0.8491 0.9015 0.9337

14963 102307200071282 0.2082 0.3647 0.4959 0.6022 0.6896 0.7520 0.8077

10571 102307200026812 0.1776 0.4492 0.6748 0.8167 0.9007 0.9475 0.9723

11609 102310800150260 0.0783 0.2416 0.4121 0.5612 0.6764 0.7681 0.8391

11218 102307200026812 0.0662 0.2718 0.5107 0.7055 0.8340 0.9092 0.9528

11015 102307200025078 0.0538 0.1835 0.3281 0.4652 0.5769 0.6746 0.7524

13047 102307200079832 0.0299 0.2054 0.4611 0.6819 0.8281 0.9131 0.9590

11015 102307200063734 0.0240 0.2666 0.6251 0.8567 0.9546 0.9865 0.9966

13047 102307200063622 0.0093 0.0996 0.3150 0.5550 0.7392 0.8639 0.9345

12204 102307200069204 0.0032 0.0113 0.0239 0.0409 0.0587 0.0810 0.1064

13047 102307200100922 0.0031 0.0116 0.0240 0.0380 0.0551 0.0795 0.1037

13047 102307200076822 0.0018 0.0117 0.0332 0.0678 0.1129 0.1663 0.2230

11090 102307200002920 0.0010 0.0189 0.0824 0.1960 0.3392 0.4826 0.6217

11015 102307200067188 0.0009 0.0198 0.0840 0.1991 0.3413 0.4907 0.6249

11167 102307200077066 0.0004 0.0059 0.0257 0.0705 0.1394 0.2235 0.3198

11609 102307200063624 0.0003 0.0083 0.0435 0.1257 0.2595 0.4040 0.5432

12236 102307200039258 0.0002 0.0031 0.0214 0.0671 0.1414 0.2430 0.3609

14963 102307200082318 0.0002 0.0028 0.0138 0.0388 0.0825 0.1466 0.2277

10571 102307200065038 0.0001 0.0002 0.0011 0.0031 0.0065 0.0119 0.0220

10571 102307200081308 0.0001 0.0017 0.0126 0.0377 0.0810 0.1412 0.2159

11090 102307200066162 0.0001 0.0004 0.0033 0.0116 0.0321 0.0625 0.1099

11575 102307200067182 0.0001 0.0053 0.0408 0.1315 0.2824 0.4617 0.6299

12020 102307200082318 0.0001 0.0013 0.0065 0.0202 0.0455 0.0818 0.1318

10571 102307200002148 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

10571 102307200031898 0.0000 0.0004 0.0029 0.0152 0.0449 0.1001 0.1783

10571 102307200051672 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

10571 102307200063606 0.0000 0.0000 0.0001 0.0014 0.0121 0.0388 0.0993

10571 102307200071952 0.0000 0.0000 0.0000 0.0000 0.0000 0.0002 0.0003

10571 102307200072006 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

10571 102307200072010 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0039

10571 102307200072028 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

10571 102307200074292 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

10571 102307200078432 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

10571 102307200078722 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11015 102307200002148 0.0000 0.0000 0.0000 0.0000 0.0003 0.0006 0.0014

11015 102307200020716 0.0000 0.0000 0.0000 0.0000 0.0001 0.0001 0.0002

11015 102307200031898 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11015 102307200031902 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11015 102307200067986 0.0000 0.0000 0.0000 0.0001 0.0001 0.0001 0.0001

11015 102307200068660 0.0000 0.0000 0.0000 0.0000 0.0002 0.0047 0.0140

11015 102307200068664 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11015 102307200071940 0.0000 0.0001 0.0002 0.0003 0.0012 0.0029 0.0063

11015 102307200074612 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11015 102307200074746 0.0000 0.0001 0.2902 0.9652 0.9998 1.0000 1.0000

11015 102307200080838 0.0000 0.0000 0.0000 0.0002 0.0008 0.0019 0.0045

11015 102307200081034 0.0000 0.0000 0.0000 0.0000 0.0000 0.0002 0.0004

11015 102307200082700 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11015 102421077713040 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11090 102307200030136 0.0000 0.0001 0.0013 0.0057 0.0137 0.0301 0.0555

11090 102307200057650 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11090 102307200067986 0.0000 0.0002 0.0024 0.0094 0.0233 0.0434 0.0721

11090 102307200071282 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11090 102307200074780 0.0000 0.0119 0.2986 0.8110 0.9790 0.9989 0.9999

11090 102307200134660 0.0000 0.0000 0.0001 0.0004 0.0009 0.0028 0.0051

11090 102310800150286 0.0000 0.0004 0.0014 0.0035 0.0078 0.0131 0.0215

11132 102307200026782 0.0000 0.0001 0.0004 0.0018 0.0062 0.0135 0.0251

11132 102307200037952 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11132 102307200051728 0.0000 0.0034 0.0350 0.1351 0.3126 0.5098 0.6925

11132 102307200057480 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0004

11132 102307200063606 0.0000 0.0006 0.0058 0.0351 0.1170 0.2646 0.4392

11132 102307200066162 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11132 102307200071940 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11132 102307200071952 0.0000 0.0000 0.0000 0.0006 0.0039 0.0095 0.0197

11132 102307200074766 0.0000 0.0000 0.0000 0.0000 0.0000 0.0002 0.0013

11132 102307200074806 0.0000 0.0000 0.0021 0.0232 0.1067 0.2669 0.4830

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11167 102307200025712 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11167 102307200026666 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11167 102307200030648 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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11167 102307200061424 0.0000 0.0000 0.0000 0.0004 0.0006 0.0013 0.0021

11167 102307200063688 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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11167 102307200080838 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001 0.0001

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11218 102307200074052 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11218 102307200074612 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11218 102307200079622 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11218 102307200079832 0.0000 0.0038 0.0269 0.0841 0.1782 0.3143 0.4665

11218 102307200082700 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11407 102307200024706 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11407 102307200026782 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11407 102307200030146 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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11575 102307200060728 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11575 102307200061428 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11575 102307200064388 0.0000 0.0009 0.0063 0.0177 0.0418 0.0819 0.1311

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11575 102307200065466 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

11575 102307200066162 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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11873 102307200066168 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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11873 102307200071288 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001 0.0001

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12020 102307200039258 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12020 102307200065038 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12020 102307200074288 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12020 102307200074806 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12020 102307200077062 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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12105 102307200071948 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0005

12105 102307200074748 0.0000 0.0000 0.0000 0.0004 0.0034 0.0124 0.0340

12105 102307200074766 0.0000 0.0000 0.0000 0.0000 0.0001 0.0014 0.0060

12105 102307200074802 0.0000 0.0000 0.0000 0.0000 0.0000 0.0002 0.0011

12105 102307200077068 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12105 102307200081548 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12204 102307200038096 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001

12204 102307200038366 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12204 102307200067990 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12204 102307200071948 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12204 102307200072030 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12236 102307200006028 0.0000 0.0020 0.0305 0.1563 0.3723 0.6061 0.7918

12236 102307200025714 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12236 102307200036690 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12236 102307200037810 0.0000 0.0000 0.0002 0.0017 0.0061 0.0142 0.0241

12236 102307200072014 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12236 102307200073852 0.0000 0.0000 0.0000 0.0000 0.0001 0.0010 0.0093

12236 102307200078722 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

12236 102307200079622 0.0000 0.0000 0.0001 0.0013 0.0040 0.0127 0.0315

12236 103788201631842 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

13047 102307200002190 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

13047 102307200006008 0.0000 0.0000 0.0000 0.0000 0.0001 0.0011 0.0017

13047 102307200028388 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

13047 102307200057650 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001 0.0002

13047 102307200067188 0.0000 0.0000 0.0000 0.0000 0.0000 0.0005 0.0015

13047 102307200067988 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

13047 102307200072008 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

13047 102307200074850 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

13047 102307200081312 0.0000 0.0010 0.0073 0.0191 0.0461 0.0870 0.1313

13047 102307200144888 0.0000 0.0000 0.0000 0.0023 0.0121 0.0386 0.1020

14963 102307200002190 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001 0.0001

14963 102307200023948 0.0000 0.0000 0.0004 0.0045 0.0172 0.0470 0.0978

14963 102307200025554 0.0000 0.0002 0.0009 0.0034 0.0070 0.0149 0.0249

14963 102307200067182 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001 0.0004

14963 102307200074290 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

14963 102307200081312 0.0000 0.0004 0.0011 0.0034 0.0077 0.0154 0.0262