

SC1x Mid Term Practice Sheet

Problem 1

(i) Which of the following statements about the initialization of the Holt-Winter Model is true?

Select all correct answers

- The training set must be of the same size as the initialization set. NO – there is no such requirement
- The initialization set can also be used for training and testing. NO – we need three separate data sets.
- The sum of the seasonality indexes should always be equal to one. NO – the sum should be equal to P (number of periods)
- If there is seasonality, the initialization set should cover at least 2 periods of the seasonal trend. YES – at least two, preferably four or more
- Linear regression is the only known method for initialization. NO – there is no single best method
- None of the above. NO – as #4 is correct

(ii) Which of the statements about the Economic Order Quantity (EOQ) model are true?

Select all correct answers

- When the cost of holding inventory increases, the optimal order quantity increases. NO – if holding cost increases, it makes sense to order less quantity
- Adding a lead time to the EOQ model does not change the optimal order quantity. YES – lead time does not impact the order quantity, but you need to place the order before inventory reaches 0
- In the EOQ model, the total cost and the total relevant cost are equal. NO – total cost would include the item cost, but TRC would not include this as it does not change based on order quantity
- When the cost of placing an order increases, the optimal order quantity increases. YES – if ordering cost increases, it makes sense to order more quantity, but do it less frequently
- The EOQ model is very sensitive to changes in order quantities, order cycle times, and errors in forecasting. NO – one of the benefits of EOQ is that it is fairly robust and not sensitive to these changes
- None of the above. NO – as #2 & #4 are correct

(iii) Which of the following statements about the Croston's method is true?

Select all correct answers

- It is used for forecasting products with intermittent demand. YES – this is the specific scenario for using this method
- It finds a correlation between a single dependent variable and one or more independent variables. NO – this is a definition of regression
- It takes into account the time between transactions to create the forecast. YES – the number of periods between orders (n) is used in the formula
- It applies the updating procedure for each and every period. NO – the updating procedure is applied only when a transaction occurs in the period
- It gives the same weight to all the past observations. NO – the weightage depends on alpha value
- None of the above. NO – as #1 & #3 are correct

(iv) A forecast that is slightly above the true value on average and has a low CV can be characterized as having:

Select all correct answers

- A big Mean Absolute Percent Error. NO – as the error is very slight
- A small Root Mean Squared Error. YES – as the error is very slight
- Bias, high accuracy. YES – as there is a positive bias, but CV is low
- Bias, low accuracy. NO – as the CV is low
- No bias, high accuracy. NO – as there is a positive bias
- None of the above. NO – as #2 & #3 are correct

(v) A firm is selling a fast moving SKU in four different stores. Which of the following statements is true?

Select all correct answers

- Individual store-SKU sales forecasts will be more accurate than an aggregate sales forecast for the SKU. NO – aggregating over stores will improve accuracy
- Historical sales data is unlikely to be of any use for forecasting demand in this case. NO – we will use the past data to forecast demand
- Monthly sales forecasts will be more accurate than weekly sales forecasts. YES – aggregating over time will improve accuracy
- It is important to capture the error of the forecasts, to create inventory buffers. YES – as RMSE is used to determine SD of demand, which decides safety stock
- Individual store-SKU sales forecasts will have lower coefficients of variation than an aggregate sales forecast for the SKU. NO – aggregating over stores will reduce the CV
- None of the above. NO – as #3 & #4 are correct

Problem 2 – Hyper Compute

Problem 2

After spending a few years working for food retail companies, Sharon has been hired by Hyper Compute, a company that manufactures extremely powerful computers. She has a lot of experience in inventory management, and at her new company she is expected to develop a new ordering policy for a component that is used in a few different computer models.

After looking at historical data, she gets to the conclusion that the demand for this component is incredibly stable, at 1800 units per week (assume that there are 52 weeks a year). The unit cost per component is \$ 49. On top of the cost per unit, there are administrative and operational costs involved, estimated at \$ 192 per order. The annual inventory holding rate is 15 %. The company takes ownership of the components when they are delivered to the dock of the factory.

Question 1

(i) First of all, Sharon wants to evaluate the cost of the current inventory policy. After asking her colleagues, she figures out what the current inventory policy is: to place an order of these components every four weeks.

Based on the current policy, how many units of this component does the company order every four weeks?

Round to the nearest integer value.

7200

(ii) What is the expected annual ordering cost?

Give your answer in dollars without the dollar sign. Round to the nearest integer value.

2496

(iii) What is the expected annual holding cost?

Give your answer in dollars without the dollar sign. Round to the nearest integer value.

26460

Question 2

(i) Sharon believes that the inventory policy could be improved, and she decides to use the Economic Order Quantity model.

What is the Economic Order Quantity?

Give your answer in number of parts. Round to the nearest integer value.

2211

(ii) How frequently will they have to order the EOQ? In other words, how many weeks will there be (in average) between orders?

Give your answer in number of weeks. Round to 2 decimal places.

1.23

(iii) What is the expected annual ordering cost under this ordering policy?

Give your answer in dollars without the dollar sign. Round to the nearest integer value.

8127

(iv) What is the expected annual holding cost under this ordering policy?

Give your answer in dollars without the dollar sign. Round to the nearest integer value.

8127

Question 3

The component is actually used by three different teams within the company: one team needs 1300 units per week, and in the case of the other two teams, each needs 250 units per week.

Sharon has another idea, they could implement a segregated ordering policy. Under the segregated ordering policy, each team would be responsible for ordering their own parts, and they would order their respective EOQ independently. Considering that all of the costs stay the same:

(i) What is the total expected annual ordering cost for the company under the segregated ordering policy?

Give your answer in dollars without the dollar sign. Round to the nearest integer value.

12964

(ii) What is the total expected annual holding cost for the company under the segregated ordering policy?

Give your answer in dollars without the dollar sign. Round to the nearest integer value.

12964

Question 4

Which inventory policy is the best option considering the total relevant cost?

Select the correct answer.

- Ordering every four weeks (inventory policy in Question 1)
- Segregated ordering policy using EOQ (inventory policy in Question 3)
- Aggregated ordering policy using EOQ (inventory policy in Question 2) This is the best option as the TRC is lowest at 16254 \$/yr

Problem 3 - Alternative Reality

Question 1

Alternative Reality manufactures and sells a high-tech suit that allows people to be immersed in a virtual reality world and feel the weather: cold, heat, rain, snow...

Today is January 1, 2020, and Alternative Reality has hired you to help them forecast the demand for their high-tech suit for the first quarter of 2020. You are very excited about this opportunity to demonstrate the skills you have acquired in SC1x, and have started by collecting the aggregated demand information for the last 12 months (see table below).

Year	Month	Demand (in units)
2019	Jan	120
2019	Feb	130
2019	Mar	122
2019	Apr	133
2019	May	154
2019	Jun	161
2019	Jul	166
2019	Aug	187
2019	Sep	189
2019	Oct	201
2019	Nov	203
2019	Dec	216

Alternative Reality has been using the level and trend exponential smoothing model to forecast its future demand. Shandy, another demand planner working at the company, has calculated for you the estimates of the level ($a_{\text{Dec2018}} = 104.94$) and trend ($b_{\text{Dec2018}} = 9.27$) in the end of 2018. She also recommends you to use $\alpha = 0.2$ and $\beta = 0.1$ to update these estimates on a monthly basis.

Using Shandy's initial estimates and α and β parameter suggestions, what are the estimates of the level (a) and trend (b) components in January of 2019? Round your answers to 2 decimal places.

115.37 & 9.39

Question 2

What will be the estimates of the level (a) and trend (b) components in December of 2019?
Round your answers to 2 decimal numbers.

216.22 & 9.28

Question 3

7 points possible (graded)

What will be the demand forecast for December 2019 (xNov2019,Dec2019)?
Round your answer to the nearest integer.

216

Question 4

7 points possible (graded)

What will be the Mean Absolute Percentage Error (MAPE)? Include all 2019 monthly demand forecasts in your calculation.
Enter your answer as a percentage with two decimal digits (e.g. for 10.492% enter 10.49).

3.48

Question 5

7 points possible (graded)

What will be the demand forecast of the first quarter of 2020 made at the end of 2019?
Round your answers to the nearest integer.

704

Problem 4 - Green World

Question 1

Green World is the most popular plant store in Downtown Boston. When people go into the store, they feel transported to the middle of the jungle. Elise just started work there and she is in charge of managing inventory. First she would like to get a good understanding of the Green World portfolio. Data management has not been the priority at this busy store, but she was able to retrieve some basic information about each product (cost, selling price, average monthly sales and standard deviation) that you can download here. Elise would like to identify the products that are generating more value to Green World, so she decides to do an ABC segmentation in which A products account for 65% of the total monthly profit and B products account for the next 25%.

(i) According to this segmentation, how many products fall under category C?

8

(ii) According to this segmentation, what kind of product is SKU 2545-96?

- A
- B
- C YES

Question 2

Elise suspects that some of the plants have a very volatile demand and tend to be under or over forecasted. From now on, she wants to pay special attention to fast moving products (average monthly sales higher than 268.64) with a volatile demand (coefficient of variation higher than 0.6). Can you help her to identify these items?

(i) How many SKUs should be included in this fast moving and volatile group of products?

4

(ii) What is the contribution to profit (as a percentage of the total monthly profit) of this fast moving and volatile group of products?

Write the percentage as a decimal number with 4 decimal positions (ex. 0.6781).

0.2955

Question 3

The Devil's Ivy is the most popular product at the store. This product has been in their portfolio from day one and it receives very good reviews from customers. Elise wants to apply three simple forecasting models to this product: Naïve, Cummulative and Period 3 Moving Average. In order to do so, she has collected the monthly sales data of Devil's Ivy for the past three years (you can download the data here).

(i) First, calculate the forecast in period 36 for period 37 with the three models. Forecast for period 37 with the Naïve model:

Give your answer with two decimal positions.

187.64

(ii) Forecast for period 37 with the Cummulative model:

Give your answer with two decimal positions.

197.71

(iii) Forecast for period 37 with the Period 3 Moving Average model:

Give your answer with two decimal positions.

198.26

Question 4

6 points possible (graded)

Now, calculate the RMSE for every model used in Question 3.

(i) RMSE of the Naïve model:

Give your answer with two decimal positions.

40.20

(ii) RMSE of the Cumulative model:

Give your answer with two decimal positions.

29.62

(iii) RMSE of the Period 3 Moving Average model:

Give your answer with two decimal positions.

28.04

Question 5

(i) Beyond Devil's Ivy, many specialty plants are sold at Green World. There is one specific product that Elise loves: the teeny tiny cactus. By further looking at the data, Elise discovers that monthly demand of teeny tiny cactuses follows a Normal distribution with a mean of 376.86 and a standard deviation of 96.64.

If Green World currently has a stock of 484 teeny tiny cactuses, what is the probability of running out of them?

Write the probability as a number with 4 decimal positions (ex. 0.8354).

0.1338

(ii) Elise does not want to run out of teeny tiny cactuses, because they are the trademark of Green World and play an important role in their marketing strategy.

How many teeny tiny cactuses should Green World have in stock in order to reduce the probability of running out to 4.16%?

Round your answer to the nearest integer.

545

Question 6

Green World sells a very expensive product, the Giant Fleshy Plant. Each Giant Fleshy Plant is sold in a beautifully decorated hand-made clay pot. Elise has studied the monthly demand for this product and she figured out that it follows a Poisson distribution with a mean of 9.15. A local artisan delivers 8 of these special clay pots monthly to Green World.

(i) What is the probability for Green World to incur in stock-outs of special clay pots in one month?

Give you answer as a figure with 4 decimal positions (ex. 0.3472).

0.5639

(ii) What is the probability that the demand for Giant Fleshy Plants equals the number of special clay pots the artisan delivers every month?

Give you answer as a figure with 4 decimal positions (ex. 0.3472).

0.1294