Effects of Different Temporary Change Decay Rates in Monthly Retail Sales Time Series

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Seasonal Adjustment Practitioners Workshop 2022

Disclaimer

- Any views expressed are those of the author and not those of the U.S. Census Bureau.

Outline

- Background on Retail Sales Data
- Temporary Change Regressor
- Phase 1 Research
- Phase 2 Research

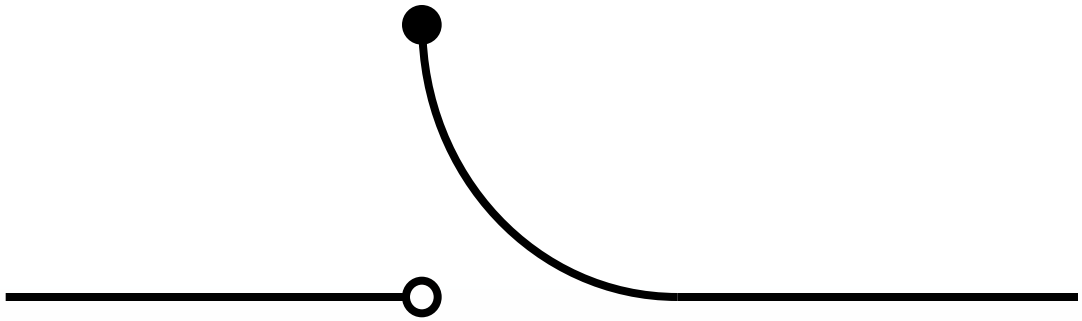
Monthly Retail Trade Survey (MRTS)

- Retail and food services stores and inventories
- Survey is authorized by Title 13, U.S. Code
- 13,000 retail businesses
- Stratified sample drawn from the Business Register
- Data users from government, academic, and business communities

Monthly Retail Trade Survey (MRTS)

- Not adjusted and seasonally adjusted series
  - 65 published not adjusted series
  - 38 published seasonally adjusted series
- Annual Review
  - Team of reviewers from across the Economic Statistical Methods Division
  - Pandemic Effects
  - Temporary Change Regressor

Temporary Change (TC) Regressor



$$TCdate = TCyyyy.mm$$

$$(TC2020.04\ or\ TC2020.4\ or\ TC2020.Apr$$

Temporary Change (TC) Regressor

Temporary change at t_0

$$TC_t^{(t_0)} = \begin{cases} 0 & for \ \ t < t_0 \\ \alpha^{t-t_0} & for \ \ t \geq t_0 \end{cases}$$

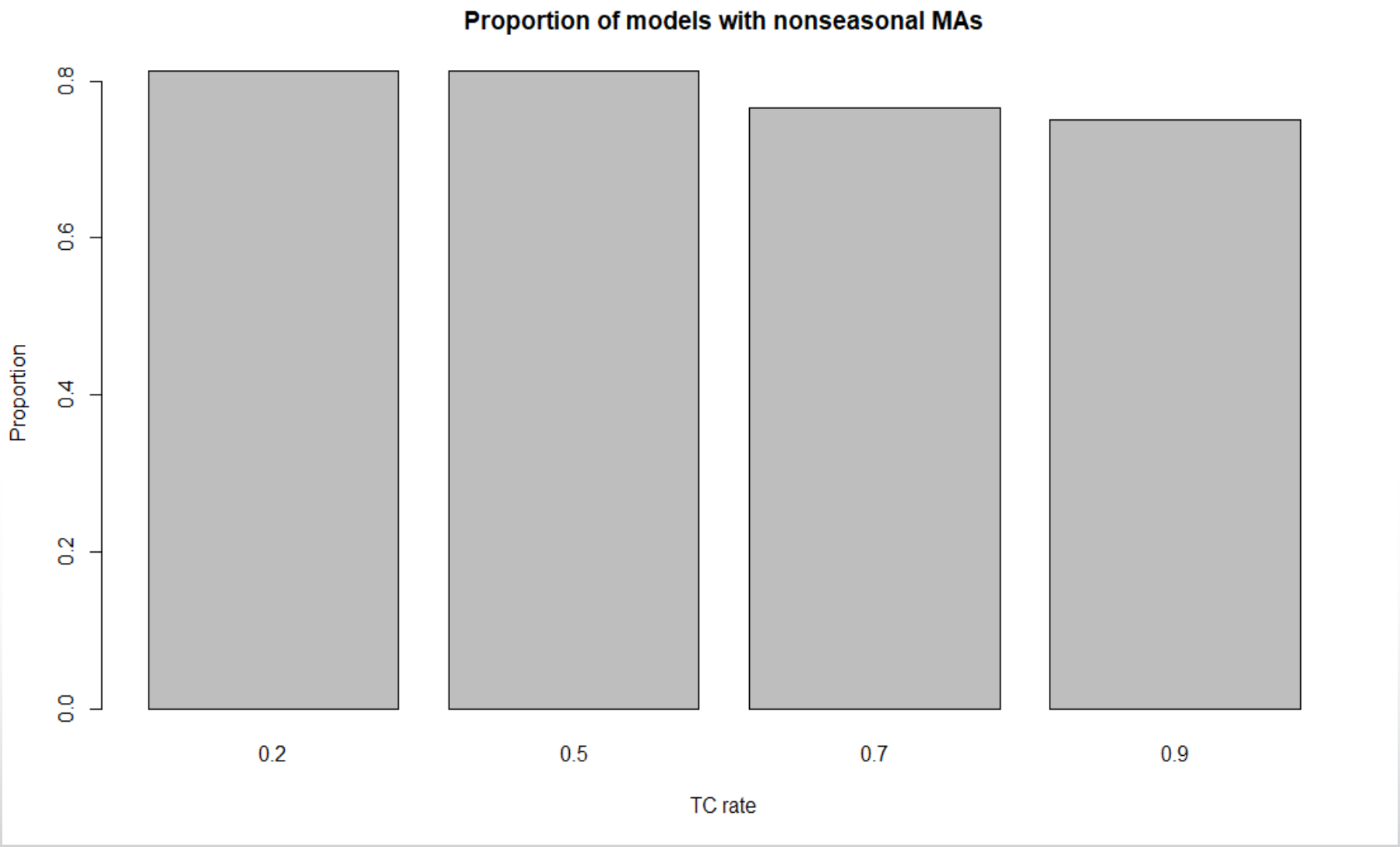
where α is the rate of decay back to the previous level, $0 < \alpha < 1$ (default: 0.7 for monthly and 0.343 for quarterly series)

Phase 1 research

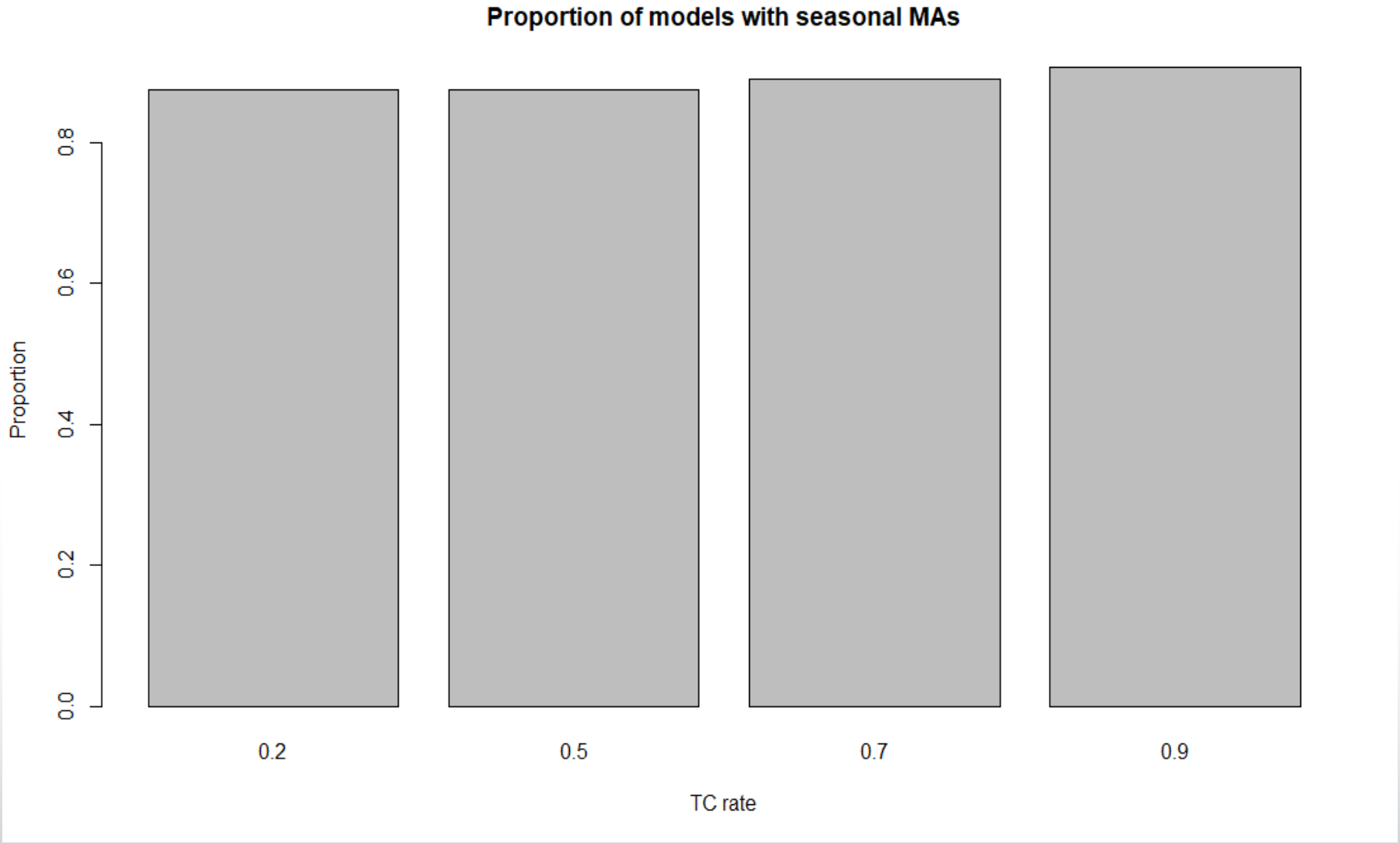
- 65 retail sales time series
  - January 2002 to June 2021
  - Automatic model: ARIMA, outliers, trading day, easter
  - Decay rates: 0.2, 0.5, 0.7, 0.9
- Error running one of the models
  - Decay Rate = 0.2
  - Regression matrix singularity
- Two options
  - Remove that series or set outliers

Phase 1 research

- Removed problem series
- 64 remaining series
- Counts and frequencies at each decay rate
  - AR, MA, outliers, TCs, trading day, easter
  - Different regressor sets



Source: Seasonal Adjustment of Monthly Retail Trade and Food Services, U.S. Census Bureau (census.gov/retail/)



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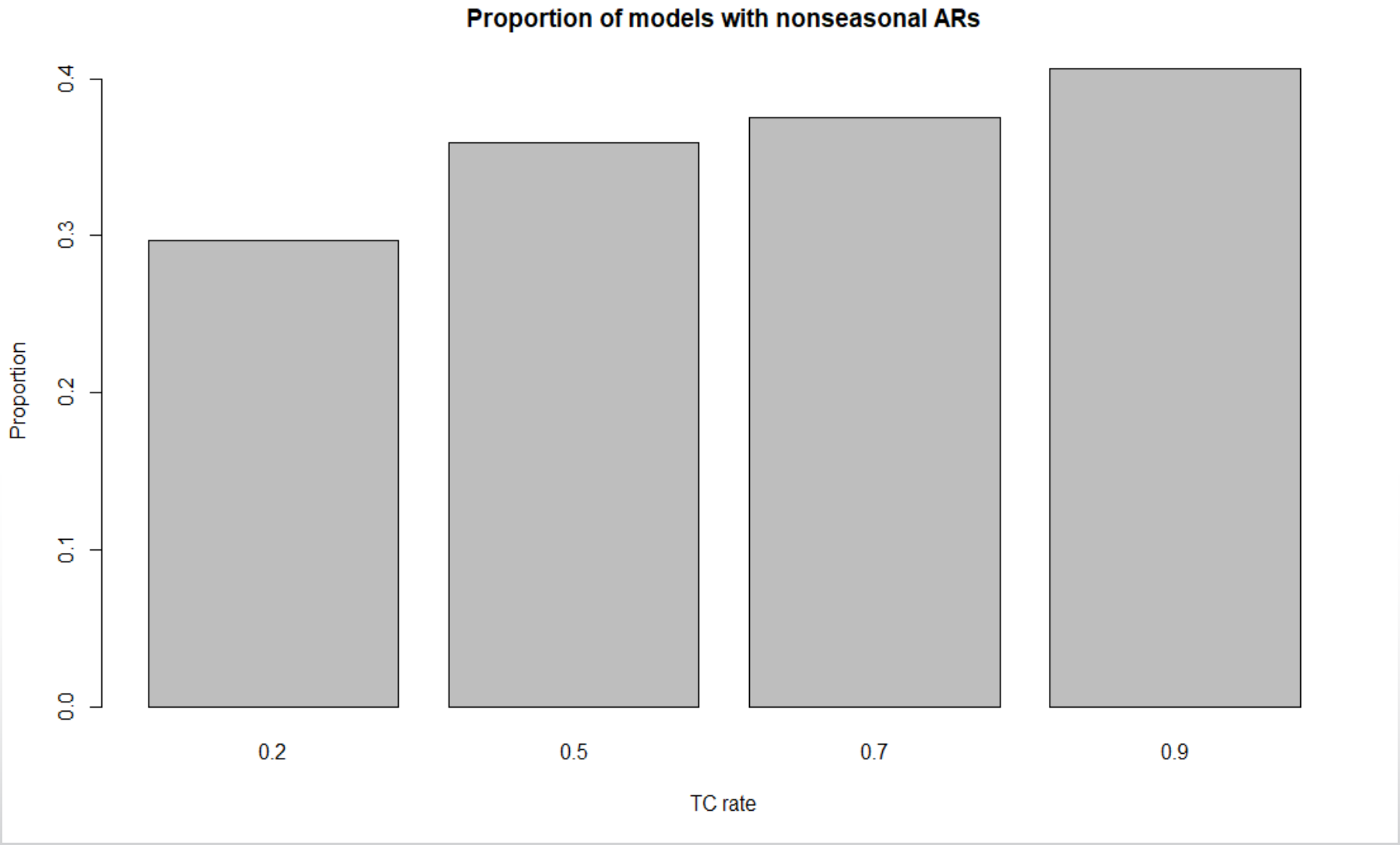

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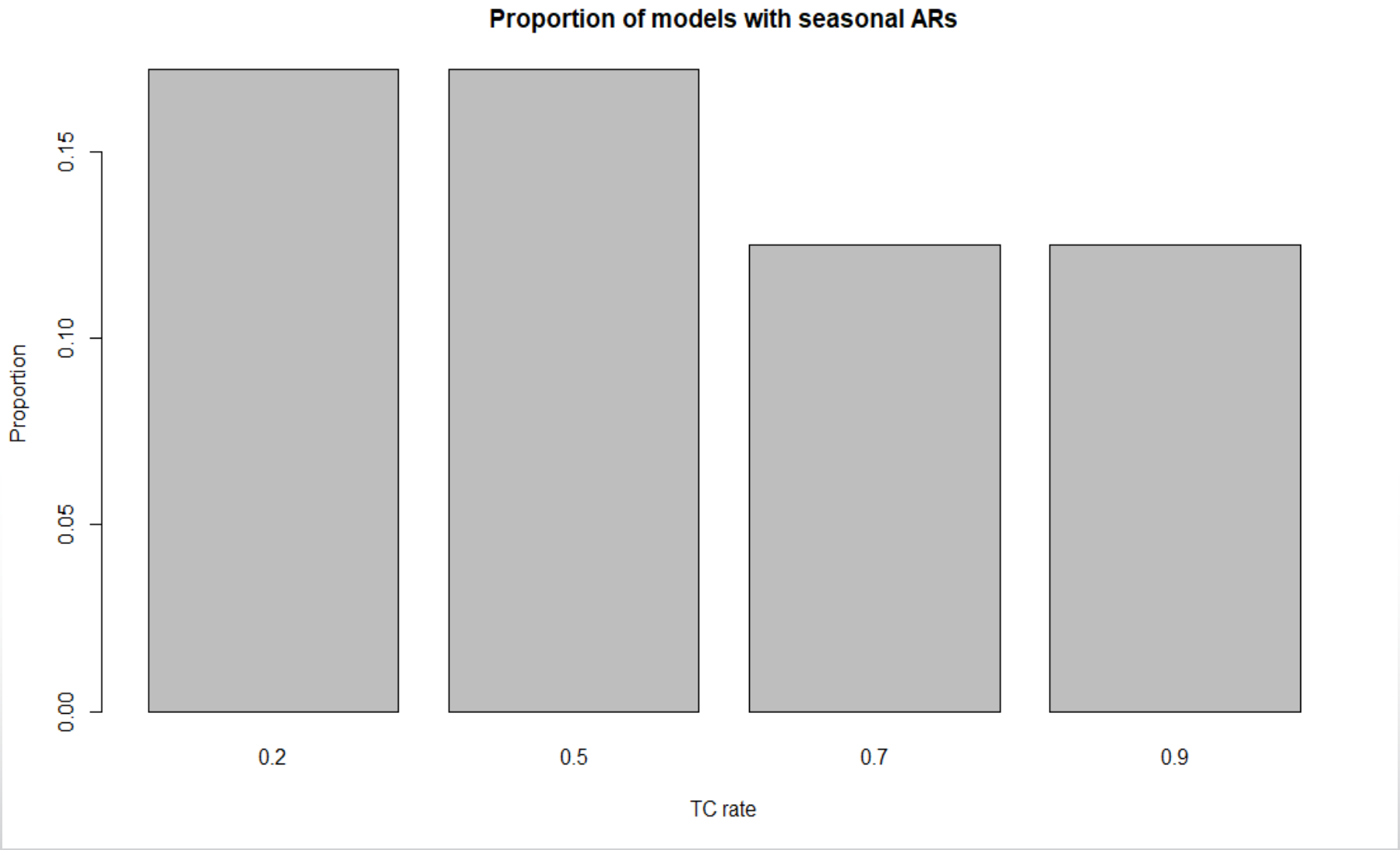

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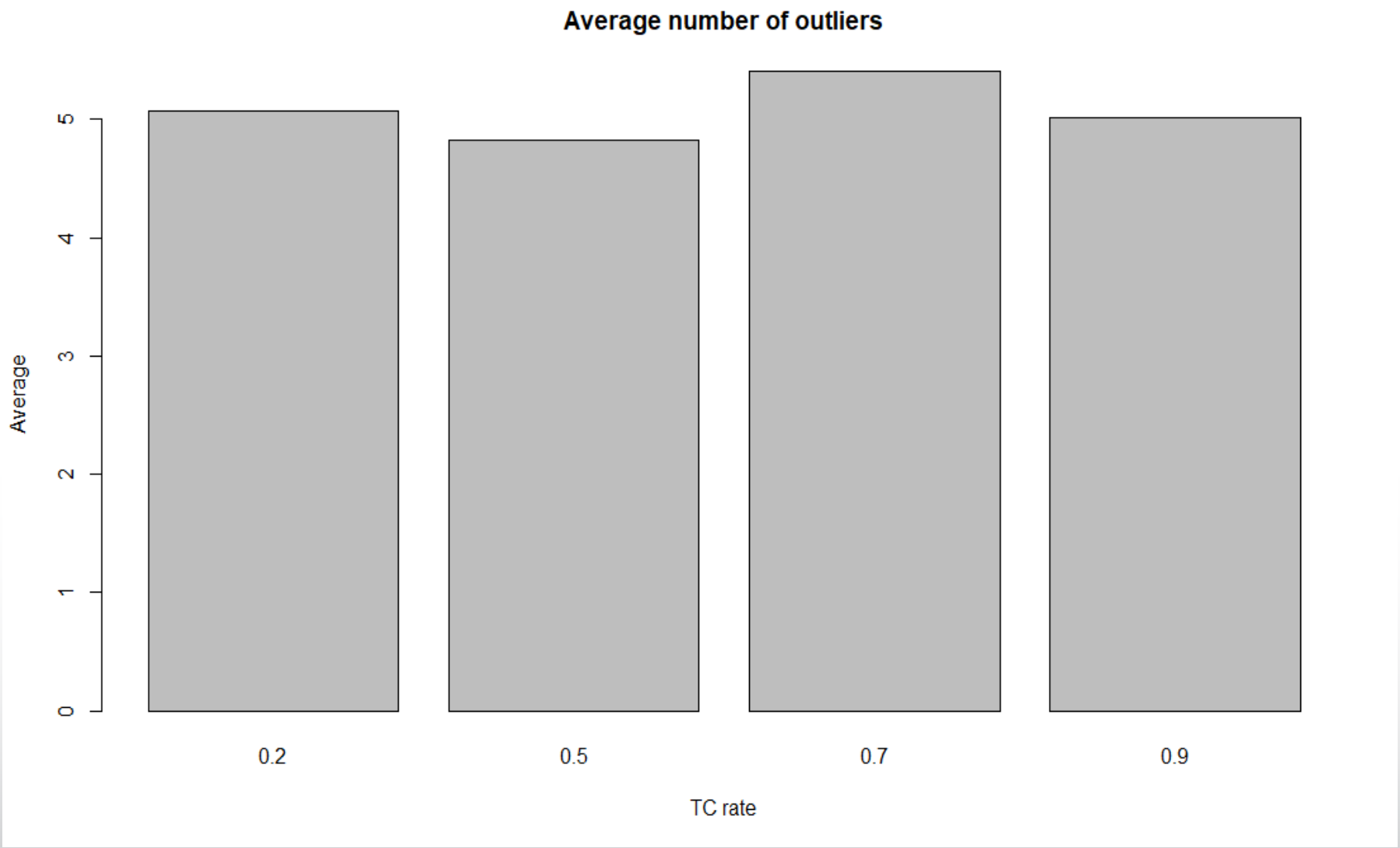

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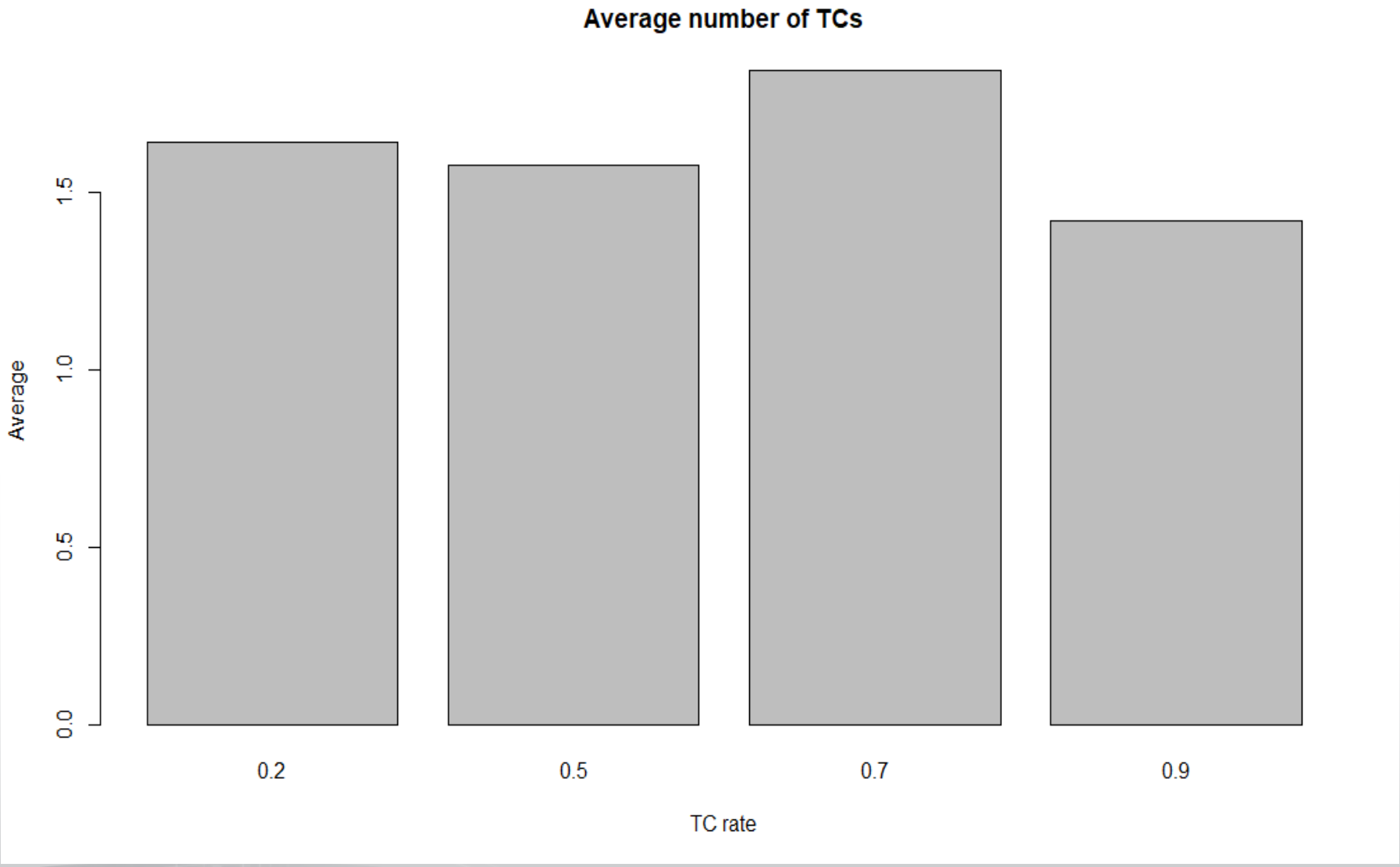

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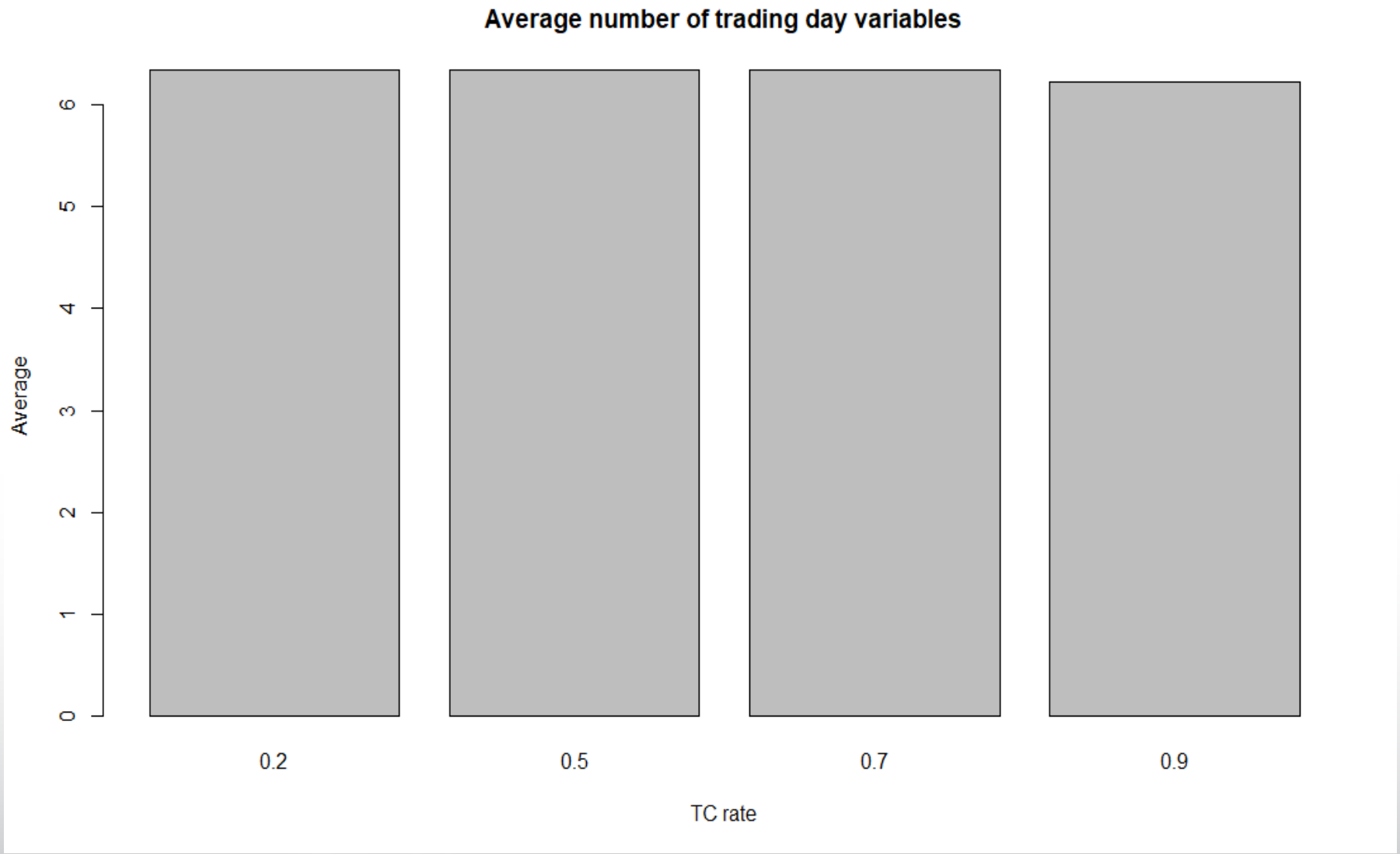

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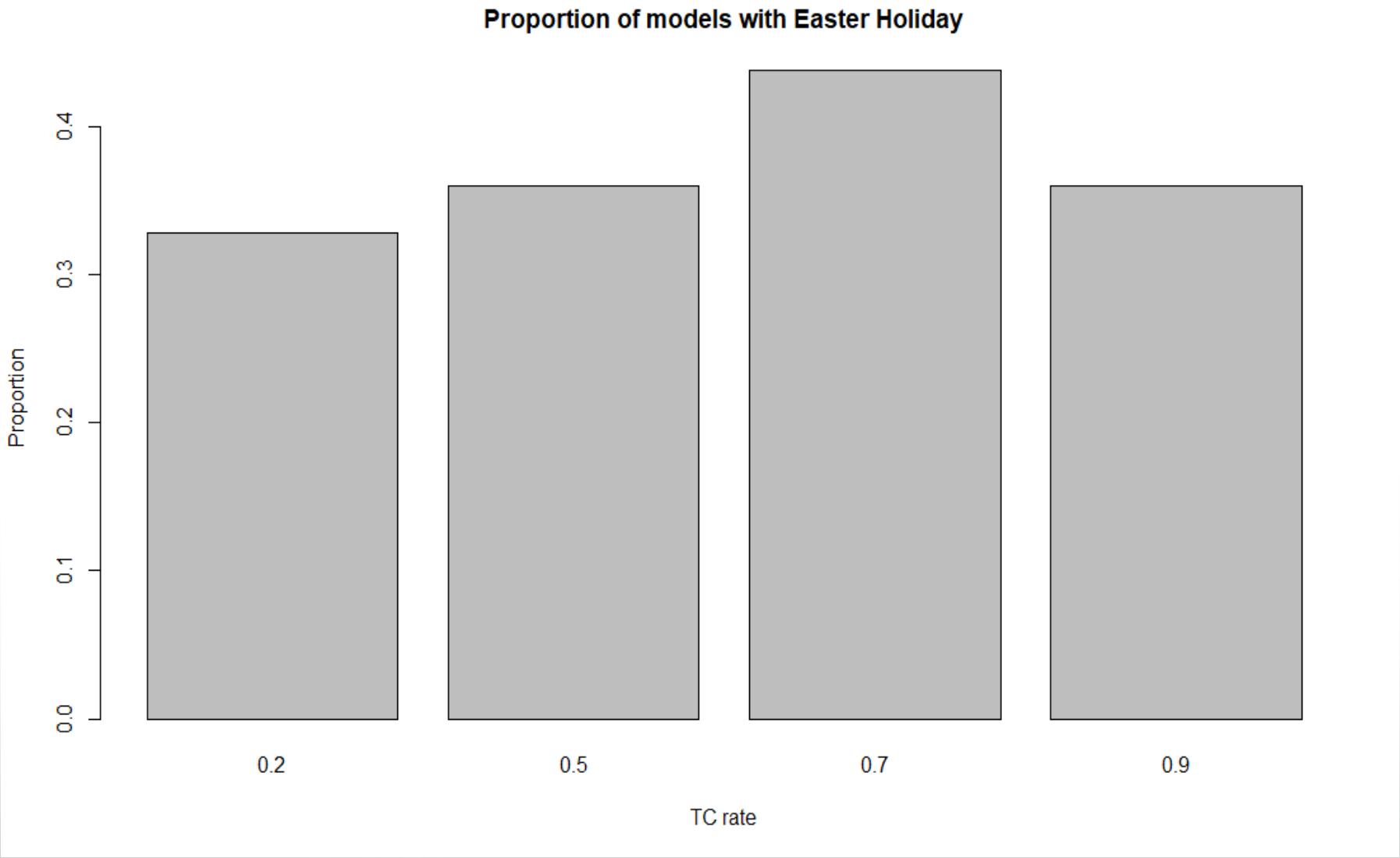

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Phase 2 research

- ARMA coefficient cross correlations
- Union of outliers
- Rerun the models
  - Potentially four sets of regression models for each series at each decay rate
  - Same ARIMA model in each regression set
  - AICC comparisons
- Changing coefficients
  - Hard coded vs auto

Phase 2 research

Percent of lowest AICCs			
Regression Set	Best Decay Rate	Total models with at least one TC	Percent
Decay rate = 0.2	0.2	57	68.4%
Decay rate = 0.5	0.5	54	88.9%
Decay rate = 0.7	0.7	54	64.8%
Decay rate = 0.9	0.9	54	57.4%

Source: Seasonal Adjustment of Monthly Retail Trade and Food Services, U.S. Census Bureau (census.gov/retail/)

- Removed series without TC regressors
- Best performing decay rate is 0.5

Conclusions

- Decay rate of 0.5 may be best for retail sales time series
- Finding only relate to Retail Sales time series
- Further research to come

References

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- Ladiray and Quenneville. 2001. *Seasonal Adjustment with the X-11 Method*. Lecture Notes in Statistics. Springer-Verlag New York, Inc. Springer, New York, NY
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QUESTIONS?

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