The Death of Stalin: Cinemetrics in 20th Century Soviet Film

Sahil Aggarwal, Aditya Chatterjee, Kevin McCraney, Altan Orhon, and Umang Sehgal

University of Washington iSchool

Author Note

This report was created for INFX 573 (Winter 2018). Corresponding author: altan@uw.edu.

Date Submitted: March 9, 2018

Abstract

We investigated whether there was a statistically significant and meaningful change in film dynamics in the Soviet Union after 1934, when the policy of socialist realism was introduced to regulate artistic production, and a subsequent change in 1953, after Stalin died. As the policy of socialist realism dictated simplicity and linearity in filmmaking, we hypothesized that median shot length would rise and that variability (and relative variability) in shot length would fall with the introduction of the policy and show signs of a return to previous levels after Stalin's death. Testing these hypotheses with analyses of covariance (ANCOVA) on 119 Soviet-era films, adjusting for the growing use of sound in film at that time, we found support for our hypothesis on median shot length but not for our hypotheses about shot length variability. We also conducted similar ANCOVAs on films produced worldwide in that era and found that the period-bound trends we observed in the Soviet Union were differentiable from global trends, lending further support for our hypothesis.

One-Sentence Summary

We discovered there were statistically significant increases in the median value and variability of shot lengths for films made in the Soviet Union after 1934 (when the policy of socialist realism was introduced to regulate artistic production), and again in 1953 (after Stalin died), lending some support to the hypothesis that the dynamics of film were palpably impacted by state policy.

Introduction

Our research project investigated cinemetric data (related to scene length and frequency of cuts) in a large dataset of several movies across the 20th century. We wished to answer the following research question: is there a statistically significant and substantial change in film dynamics in the Soviet Union after 1934, when the policy of socialist realism (SR)—which discouraged abstract and experimental forms of expression (Taylor & Christie, 1991)—was introduced to regulate artistic production? Further, was there a change after Stalin died, in 1953?

To unpack our research question, one requires a cursory understanding of both Russian history and film theory. Montage is a technique in film editing that assembles a series of shots into a sequence in order to condense space, time, and build narrative continuity (Eisenstein, 1949). Examining the start- and end-points of shots across the duration of the film allows us to understand the dynamics of the film. For example, if there is a large number of shots compressed into a short period of time, the director may be attempting to build tension toward a climactic point.

After the Russian Revolution (1917), the Bolshevik regime needed to consolidate power. They had taken control of a massive country with poor social cohesion and education. The leaders (particularly Lenin, but later Stalin) used art as a political tool to spread their message. Visual art like cinema was immediately comprehensible to the uneducated masses and was considered crucial to furthering the cause of the revolutionaries. Stalin mandated SR in 1933, requiring all modes of artistic expression to champion the life of the proletariat (Taylor & Christie, 1991).

We theorize that state-mandated SR would influence cinema in the same way that it influenced visual and literary arts. To meet this policy requirement, directors would use longer scenes in their films and simpler montage—real life is continuous, without cuts. Specifically, we hypothesize that shot length would increase during SR and possibly fall in the post-Stalin era, after SR policies were relaxed, and that variability in shot length would show the opposite pattern by falling during SR and rising up again afterward.

This project sits squarely within the digital humanities, an intersectional discipline that pulls techniques from computer science & statistics, as well as methodologies from the liberal arts. The goal of the discipline is to understand large-scale change in artistic production by analyzing a society’s cultural output in aggregate. Within the field, statistical techniques have been used to identify anonymous authors (Mosteller, 2009) or gauge demographic trends across literary works (Moretti, 2015).

While much work has gone into using text as data, there has been little scholarly work related to analyzing cinemetric data. Existing research has focused on bodies of data related to the oeuvre of one director (Hauske, 2007), or similarities across a handful of genre films (Salt, 2001). Thus, the work we produce here is a strong contribution the field, as it serves to illuminate the deep ties between artistic production and ideology by quantifying impact on filmic aesthetics.

Methods

Our data comes from Cinemetrics (Cinemetrics, n.d.), which comprises human-recorded shot length measurements from over 18,000 films. We have 157 film records from the Soviet Union before 1934 (from 1908), 40 from 1934-1953, and 66 from 1954-1979. Because our intention is to judge whether differences in film dynamics before, during, and after SR can be attributed to something other than chance or history effects, we will use inferential statistics. We operationalize change in film form as change in location (e.g., median) or dispersion (e.g., median absolute deviation) of shot length. To assess the degree and statistical significance of changes, we will use analysis of covariance with three groups (pre, during, and post), with presence of sound as a covariate.

The first step of the process was collecting the data. Cinemetrics does not offer any means of downloading their metrics en masse, so we had to write a script to scrape all of the web pages. Cinemetrics presents qualitative features (film name, director, country), summary quantitative features (shot length, number of shots per film, median/average shot length per film, etc.), and raw shot-scale data.

Next, we built a tabular dataset by scraping the HTML for every page and extracting our metrics of interest. We then output this data into a text file, deduplicating films that had multiple entries. We also removed films that were less than 40 minutes in length to rule out any partially entered films in the database and to constrain our analysis to films considered feature length (American Film Institute, n.d.), as short films might have different dynamics. As many of the qualitative fields in the database were inconsistent or incorrect, we used the IMDB IDs specified for the films to query open APIs and datasets, namely OMDB (OMDB, n.d.) and TMDB (TMDB, n.d.), and obtain richer film metadata. Where IMDB IDs were lacking, we searched the databases for the film titles and compared Cinemetrics-stated runtimes in order to select the most suitable candidate among search results.

In the metadata linkage process we also obtained the number of spoken languages in a film. Sound became prevalent in film in the late 1920s and early 1930s, and afforded directors new techniques in cinema (Baxter, 2014). Visuals were no longer the only channel for storytelling. Additionally, sound is frequently used in film to establish continuity between shots, which is likely to impact visual dynamics (Taylor & Christie, 1991). The additional metadata allows us to account for the putative impact of sound on film dynamics.

Results

Descriptive Statistics

Descriptive statistics for the set of Soviet films used in final analysis are shown in Table 1. Table 2 shows descriptive statistics for summary statistics from Cinemetrics that was created at an earlier stage in the analysis.

Analyses of Covariance for Soviet-Made Films

To test our hypotheses that film dynamics could be predicted by era, we applied analysis of covariance (ANCOVA) to linear models predicting median shot length (MSL), Q_n, and Q_n/MSL from the era in which the movie was produced (pre-SR, SR, and post-Stalin), with whether the movie had sound and the prevalence of sound in the movie's year of production as interactive covariates. We used Q_n (a.k.a. the Rousseeuw–Croux estimator) as a robust alternative to standard deviation that performs better than median absolute deviation (Rousseeuw & Croux, 1993), and its ratio to the median as an analogue to the coefficient of variation reported by Cinemetrics, in consideration of the frequent departures from normality of shot length distribution within films.

The covariates allow us to control for the impact of sound on film dynamics. Although sound presence and sound prevalence are obviously collinear ($r = .38$), since our intent is control and not explanation, we considered retaining both predictors acceptable per Cohen, Cohen, West, and Aiken (2003). We used planned treatment contrasts to compare differences between the eras using the SR era as the baseline. We referred to Field, Miles, and Field (2012) to interpret the ω^2 effect sizes, which are less biased than the widespread η^2 or ηp^2 effect sizes (Albers & Lakens, 2017).

Before each test, we ran diagnostics to check for outliers, heteroskedasticity, autocorrelation, non-normality of residuals, and multicollinearity. Normality of residuals was violated in every case per the Shapiro-Wilk test of normality when the response variables were untransformed. Once they were log-transformed, all tests were passed successfully. Log transformation for analysis is consistent with the literature in this field, as almost all of the variables have a log-normal distribution (Baxter, 2012).

We found a large main effect of era on (log) MSL, $F(2, 113) = 27.8$, $p < .001$, $\omega^2 = .207$. The contrast between eras 1 and 2 was significant, $p < .001$, $\beta = -.513$, as was that between eras 3 and 2, $p = .002$, $\beta = .28$, indicating that MSL tended to rise every era. There was a small effect of sound, $F(1, 113) = 5.38$, $p = .022$, $\omega^2 = .017$, and a medium effect of sound prevalence in year of production, $F(1, 113) = 13.8$, $p < .001$, $\omega^2 = .049$. The interaction of sound and sound prevalence had a small effect, $F(1, 113) = 6.15$, $p = .015$, $\omega^2 = .02$.

Next, we found a large main effect of era on (log) Q_n of shot length, $F(2, 113) = 27$, $p < .001$, $\omega^2 = .159$. The contrast between eras 1 and 2 was significant, $p < .001$, $\beta = -.443$, as was that between eras 3 and 2, $p < .001$, $\beta = .326$., indicating that the variability of shot length tended to rise every era. There was a small effect of sound, $F(1, 113) = 6.07$, $p = .015$, $\omega^2 = .015$, and a small effect of sound prevalence in year of production, $F(1, 113) = 9.91$, $p = .002$, $\omega^2 = .027$. The interaction of sound and sound prevalence had a small effect, $F(1, 113) = 6.87$, $p = .01$, $\omega^2 = .018$.

Finally, we found a small main effect of era on (log) Q_n of shot length by MSL, $F(2, 113) = 7.5$, $p = .001$, $\omega^2 = .027$. The contrast between eras 1 and 2 was not significant, $p = .785$, but the contrast between eras 3 and 2 was significant, $p < .001$, $\beta = .357$, indicating that the relative variability of shot length was about the same in the first two eras but higher in the third one. The effect of sound was insignificant, $F(1, 113) = 2.62$, $p = .108$, as was that of sound prevalence, $F(1, 113) = 0.384$, $p = .537$, and so was the interaction of these two, $F(1, 113) = 2.8$, $p = .097$.

Analyses of Covariance for Films Worldwide
To assess whether the effects we observed were confined to the Soviet Union or merely a reflection of global filmmaking trends, we ran ANCOVAs on a set of 2,548 films that were produced in the eras of interest all over the world (2,429 of which were not Soviet-made). The models we specified were similar to those shown above, with the addition of being Soviet-made as a grouping factor, and differentiated sound prevalence factor for Soviet and non-Soviet films (calculated from the percentage of Soviet or non-Soviet films released with sound in the year of production).

We found a significant but insubstantial effect of era on (log) MSL, $F(2, 2539) = 3.13$, $p = .044$, $\omega^2 = .001$. There was a significant but insubstantial effect of being Soviet-made, $F(2, 2539) = 3.13$, $p = .006$, $\omega^2 = .001$, and a significant though small interaction effect of era and being Soviet-made, $F(2, 2539) = 32.9$, $p = .001$, $\omega^2 = .022$. For interactive effects between being Soviet-made and eras, the contrast for eras 1 and 2 was significant, $p < .001$, $\beta = -.108$, as was that between eras 3 and 2, $p < .001$, $\beta = .119$. Globally, the contrast between eras 1 and 2 was not significant, $p = .618$, but the contrast between eras 3 and 2 was significant, $p = .012$, $\beta = -.058$ (notably differing in sign from the Soviet case). The effect of sound presence was insignificant, $F(1, 2539) = .016$, $p = .9$. There was a significant though insubstantial effect of sound prevalence in year of production, $F(1, 2539) = 13.7$, $p < .001$, $\omega^2 = .022$. The interaction of sound and sound prevalence was insignificant, $F(2, 2539) = .065.15$, $p = .799$.

Next, we found a significant but insubstantial effect of era on (log) Q_n of shot length, $F(2, 2539) = 5.54$, $p = .004$, $\omega^2 = .002$. There was a significant but insubstantial effect of being Soviet-made, $F(2, 2537) = 21.9$, $p < .001$, $\omega^2 = .006$, and a significant though small interaction effect of era and being Soviet-made, $F(2, 2537) = 35.6$, $p = .001$, $\omega^2 = .018$. For interactive effects between being Soviet-made and era, the contrast for eras 1 and 2 was significant, $p = .005$, $\beta = -.087$, as was that between eras 3 and 2, $p < .001$, $\beta = .143$. Globally, the contrast between eras 1 and 2 was not significant, $p = .95$, but the contrast between eras 3 and 2 was significant, $p = .001$, $\beta = -.074$ (again differing in sign from the Soviet case). The effect of sound presence was insignificant, $F(1, 2537) = .064$, $p = .8$. There was a significant though small effect of sound prevalence in year of production, $F(1, 2537) = 44.7$, $p < .001$, $\omega^2 = .012$. The interaction of sound and sound prevalence was insignificant, $F(2, 2537) = .64$, $p = .424$.

Finally, we found a significant but insubstantial effect of era on (log) Q_n of shot length by MSL, $F(2, 2537) = 12.5$, $p < .001$, $\omega^2 = .003$. There was a significant though small effect of being Soviet-made, $F(2, 2537) = 81.6$, $p < .001$, $\omega^2 = .01$, and a significant though insubstantial interaction effect of era and being Soviet-made, $F(2, 2537) = 16.3$, $p < .001$, $\omega^2 = .004$. For interactive effects between being Soviet-made and era, the contrast for eras 1 and 2 was not significant, $p = .272$, but the contrast for eras 3 and 2 was significant, $p < .001$, $\beta = .15$. Globally, the contrast between eras 1 and 2 was significant, $p = .035$, $\beta = .065$, as was that for eras 3 and 2, $p = .001$, $\beta = -.086$. The effect of sound presence was insignificant, $F(1, 2537) = 0.341$, $p = 559$. There was a significant though small effect of sound prevalence in year of production, $F(1, 2537) = 190$, $p < .001$, $\omega^2 = .023$. The interaction of sound and sound prevalence was significant but insubstantial, $F(2, 2537) = 5.58$, $p = .018$, , $\omega^2 = .001$.

Exploratory Analyses
Additionally, we performed a series of exploratory analyses which did not yield any readily interpretable results. We tried using wavelets on shot-scale data per movie as input to various classifiers (support vector machine, linear discriminant analysis, random forest, etc.). The results were barely better than chance (.47-.62 accuracy), which led us to reject this methodology. We also attempted to conduct an interrupted time-series analysis but had challenges with tooling.

Discussion

The results of our analyses provide partial support for our hypotheses. The tendency for MSL to increase each era is consistent with the political pressure to create linear, easily understood films. We also found that trends in the Soviet Union were differentiable from those worldwide. However, the tendency for variability and relative variability of shot length in the Soviet Union to increase or remain the same over time is, on its face, indicative of increased dynamism over time. Indeed, in our dataset, Eisenstein's *Alexander Nevsky* (1938), which embodies a forced departure from the highly experimental montage tradition he developed, has a MSL that is more than twice that of any of his films previous, yet the variability (and relative variability) in shot length is roughly the same or higher. This might suggest a large number of longer shots bookended by shorter ones. It may be that the frantic intellectual montage achieves a greater emotional impact using short shots of similar length as opposed to a wide range of long and short shots. In any case, it is clear that shot length variability increased over time independent of sound.

Limitations
One of the major limitations of our process is that our analysis was performed on summary statistics rather than shot-level data for each film. While we attempted to work with shot-level data, we failed to create a coherent model that would represent an improvement over our simpler models. A well-developed model considering the dynamics over time within and among films might allow us to conduct a fine-grained analysis of cinematic style rather than just historical trends.

Our data also has a very strong convenience bias: Since Cinemetrics is a crowd-sourced platform, the composition of the data is based on the taste and proclivities of patrons of the site. Figure 20 shows the dramatic difference between the number of high-quality film records present in the Cinemetrics database versus those in TMDB.

References

Albers, C. & Lakens, D. (2017). Biased sample size estimates in a-priori power analysis due to the choice of the effect size index and follow-up bias. *Journal of Experimental Social Psychology*

American Film Institute. (n.d.) Retrieved from http://www.afi.com/catalog/help/

Baxter, M. (2014). Notes on cinemetric data analysis [monograph]. Retrieved from http://www.cinemetrics.lv/articles.php

Cohen, J., Cohen, P., West, S.G., & Aiken, L.S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences*. New York, NY: Routledge.

Cinemetrics. (n.d.). Retrieved January 27, 2018, from http://www.cinemetrics.lv/database.php

Eisenstein, S.M. (1949). *Film form: Essays in film theory*. (J. Leyda, Ed. & Trans.) New York: Harcourt.

Field, A. P., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. London: Sage.

Hauske, M. (2007). *Ozu, sound, and style: A cinemetrical analysis of four films*. Retrieved from http://www.cinemetrics.lv/hauske.php

Moretti, F. (2015). *Distant reading*. London, U.K.: Verso.

Mosteller, F. (2009). Who wrote the disputed federalist papers, Hamilton or Madison? *The Pleasures of Statistics*, 47-67. doi:10.1007/978-0-387-77956-0_4

OMDB. (n.d.). The Open Movie Database. Retrieved from https://www.omdbapi.com/

Rousseeuw, P.J., & Croux, C. (1993) Alternatives to the median absolute deviation. *Journal of the American Statistical Association*, 88, 1273-1283.

Salt, B. (2001). Practical film theory and its application to TV series dramas. *Journal of Media Practice* 2 (2): 98-113.

Taylor, R., & Christie, I. (1991). *Inside the film factory*. London, U.K.: Routledge.

TMDB. (n.d.). Retrieved from https://www.themoviedb.org/about?language=en

Tables

Table 1

Descriptive statistics for cinemetric features of 119 films released in the Soviet Union, 1914-1979 (computed from raw Cinemetrics data)

	M (SD)	95% CI
Length	81.18 (25.28)	[85.77, 76.59]
MSL	6.32 (4.96)	[7.22, 5.42]
Qn	51.54 (48.65)	[60.37, 42.71]
Qn/MSL	7.72 (1.15)	[7.93, 7.51]
No. shots	741.02 (567.5)	[844.04, 638]

Note. MSL = median shot length; Q_n = Rousseeuw–Croux estimator of scale.

Table 2

Descriptive statistics for cinemetric features of 132 films released in the Soviet Union, 1914-1979 (computed from Cinemetrics summary data)

	M	*SD*	Median	*MAD*
Length	82.67	25.66	81.15	21.32
ASL	10.78	8.82	7.95	5.71
MSL	6.59	5.13	5.25	3.19
MSL/ASL	.65	.11	.65	.11
No. shots	711.98	548.84	577	348.41
SL max.	100.19	74.93	84.30	57.67
SL min.	.54	.48	.40	.44
SL range	1.10	.26	1.06	.21
SD	12.20	10.19	9.35	7.78
CV	1.10	.26	1.06	.21

Note. These values were calculated for preliminary analysis and are included as documentation of our process. This is why the number of films and the summary statistics differ from those in table above. MAD = median absolute deviation; ASL = average shot length; MSL = median shot length; SL = shot length; CV = coefficient of variation.

Figures

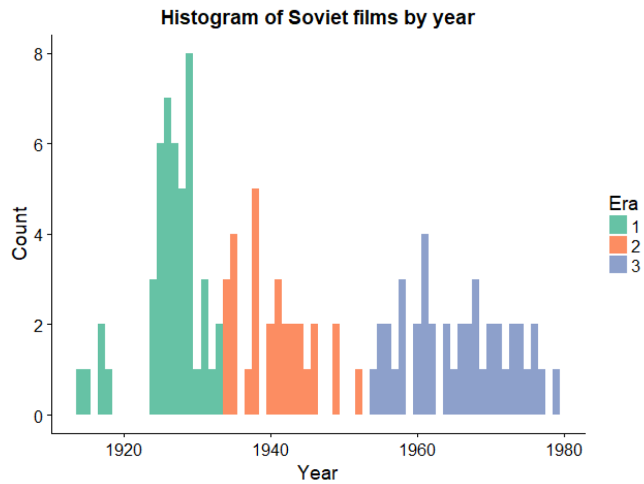

Figure 1. Year of distribution of films in the Soviet Union by era.

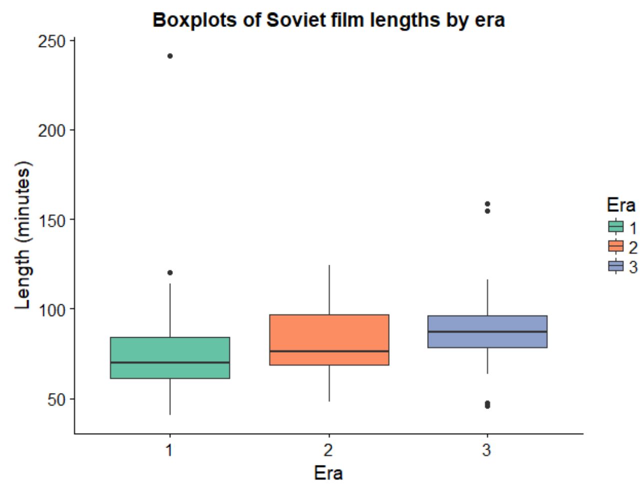

Figure 2. Length of films in the Soviet Union by era.

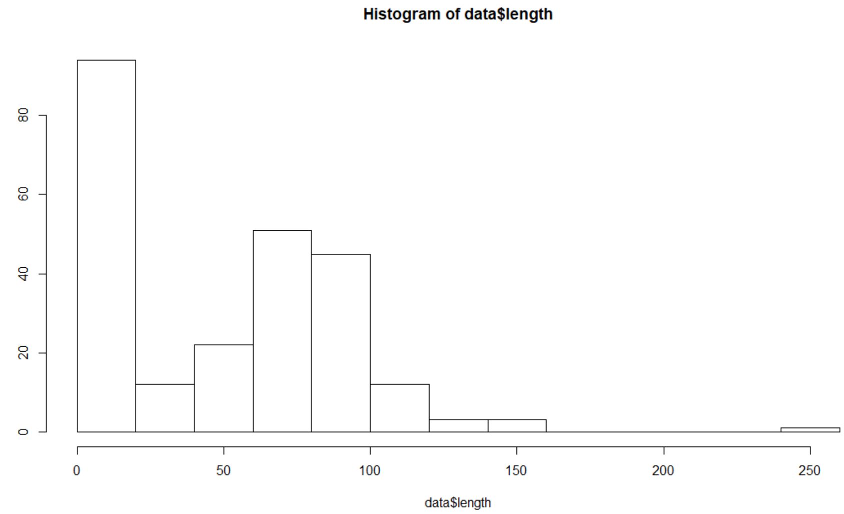

Figure 3. Histogram of length of films in the Soviet Union by era.

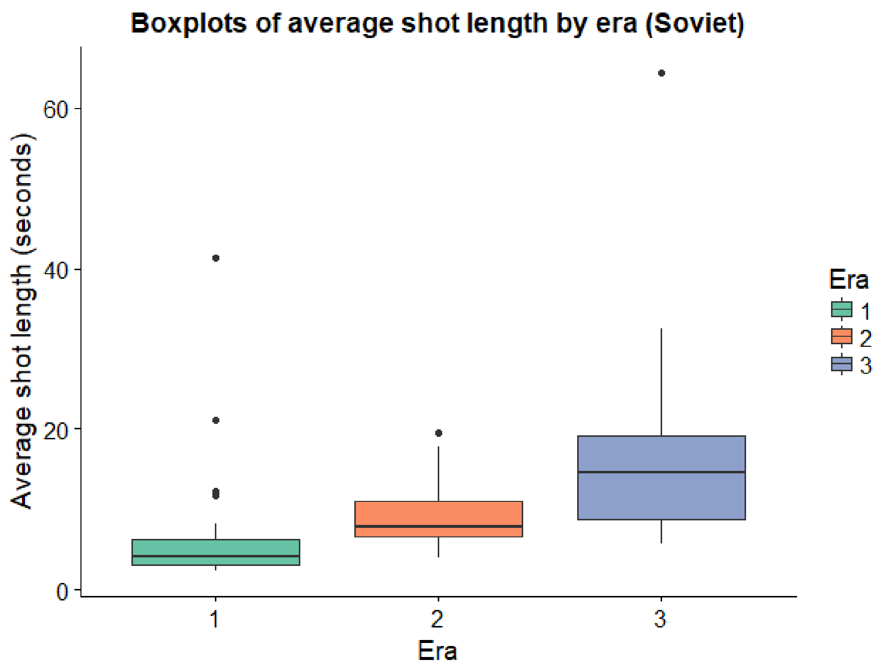

Figure 4. ASL of films in the Soviet Union by era.

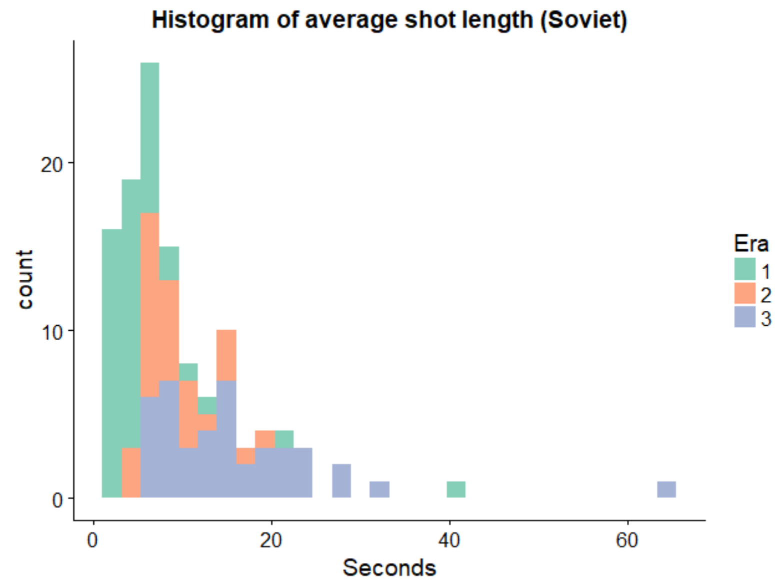

Figure 5. *Histogram of ASL of films in the Soviet Union by era.*

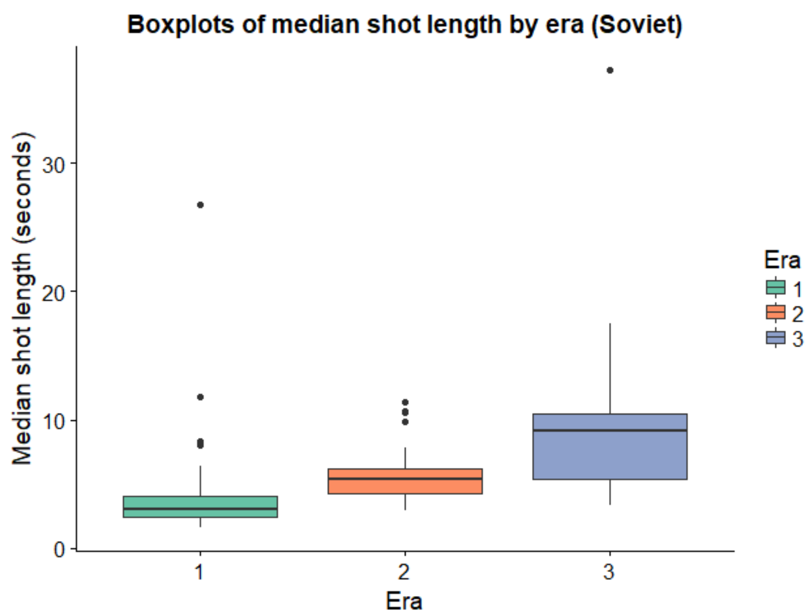

Figure 6. *MSL of films in the Soviet Union by era.*

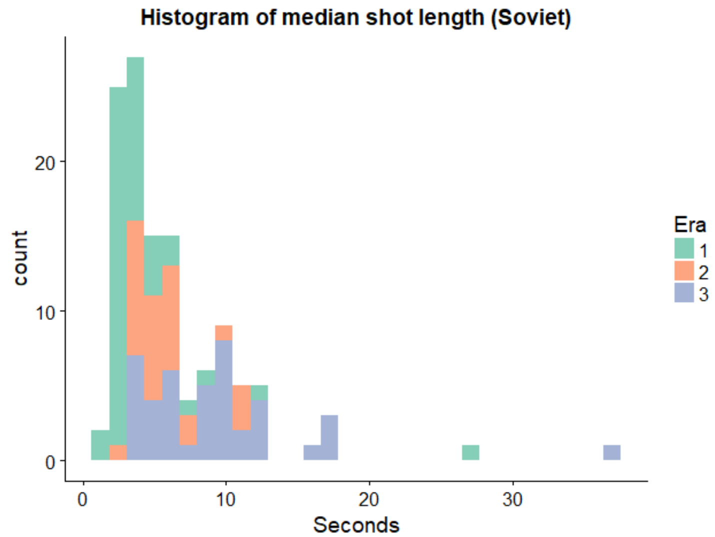

Figure 7. *Histogram of MSL of films in the Soviet Union by era.*

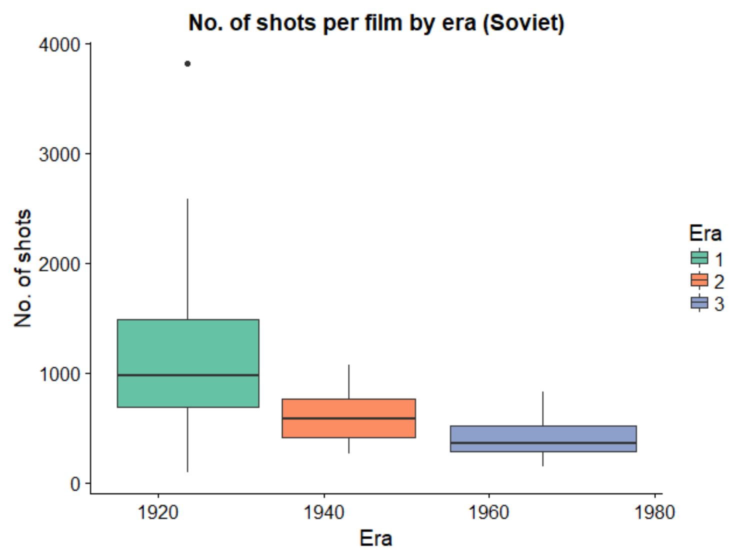

Figure 8. *Number of Shots in films in the Soviet Union by era.*

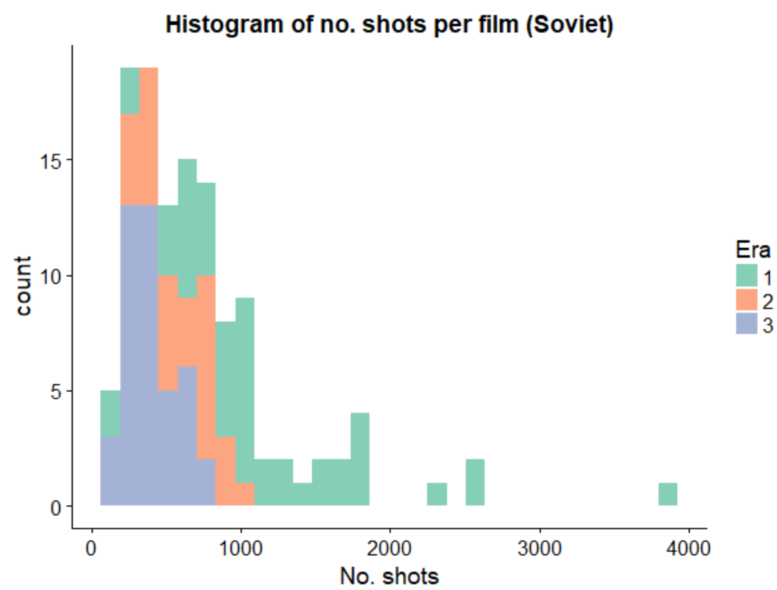

Figure 9. *Histogram of number of shots in films in the Soviet Union by era.*

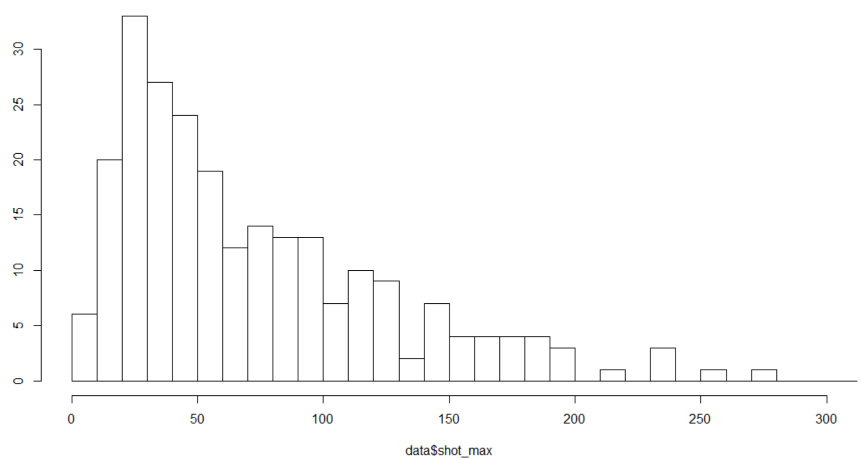

Figure 10. *Histogram of maximum shot length in films in the Soviet Union.*

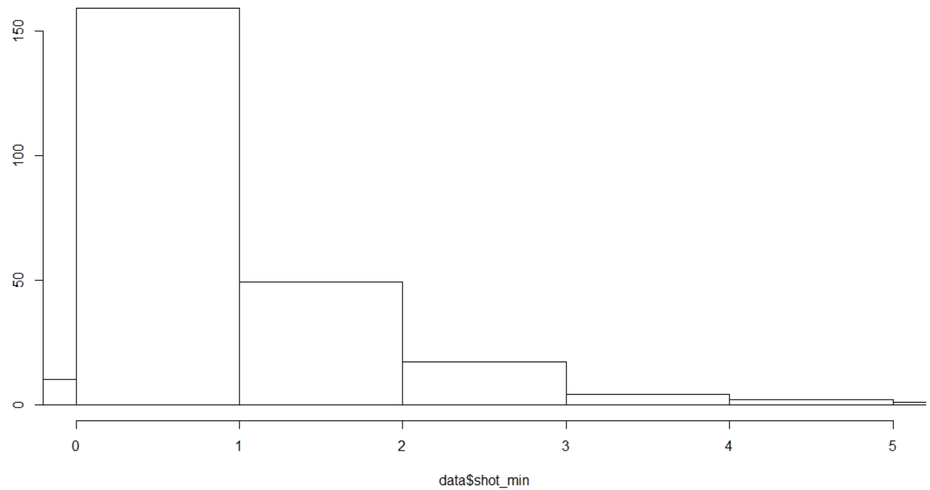

Figure 11. *Histogram of maximum shot length in films in the Soviet Union.*

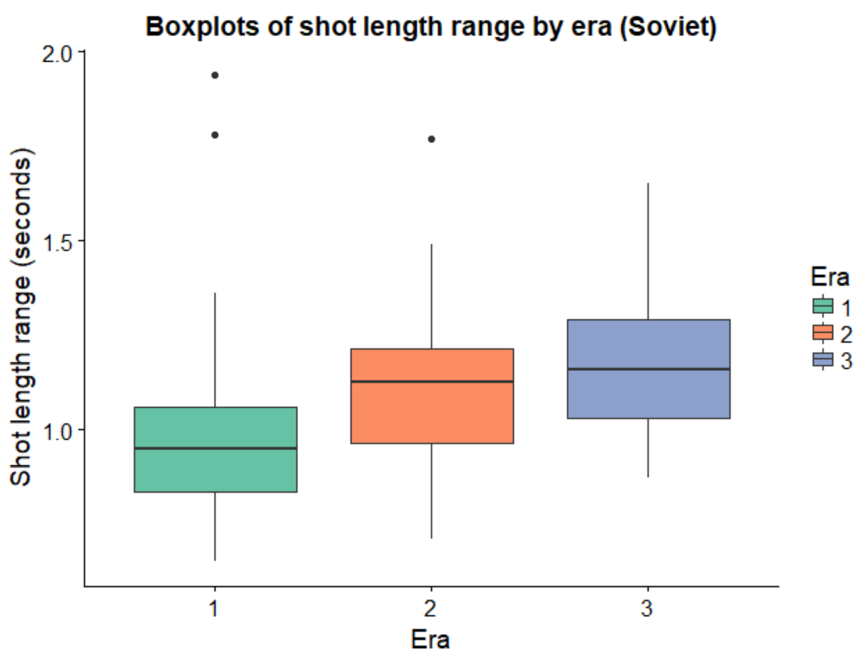

Figure 12. *Range of shot length in films in the Soviet Union by era.*

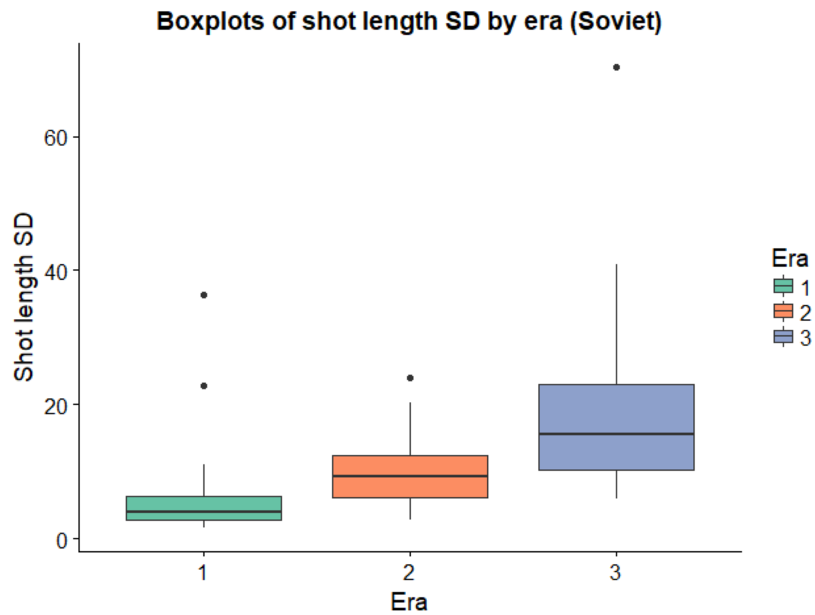

Figure 13. *Shot length standard deviation in films in the Soviet Union by era.*

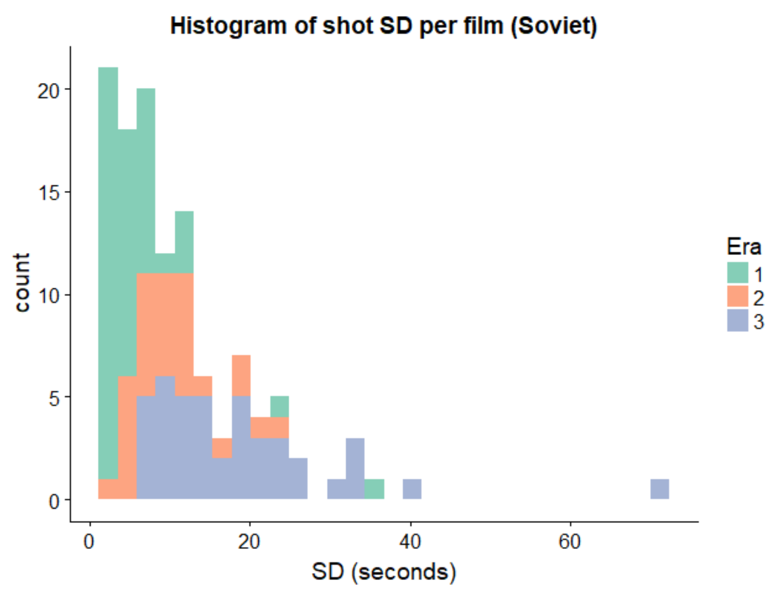

Figure 14. *Histogram of shot length standard deviation in films in the Soviet Union by era.*

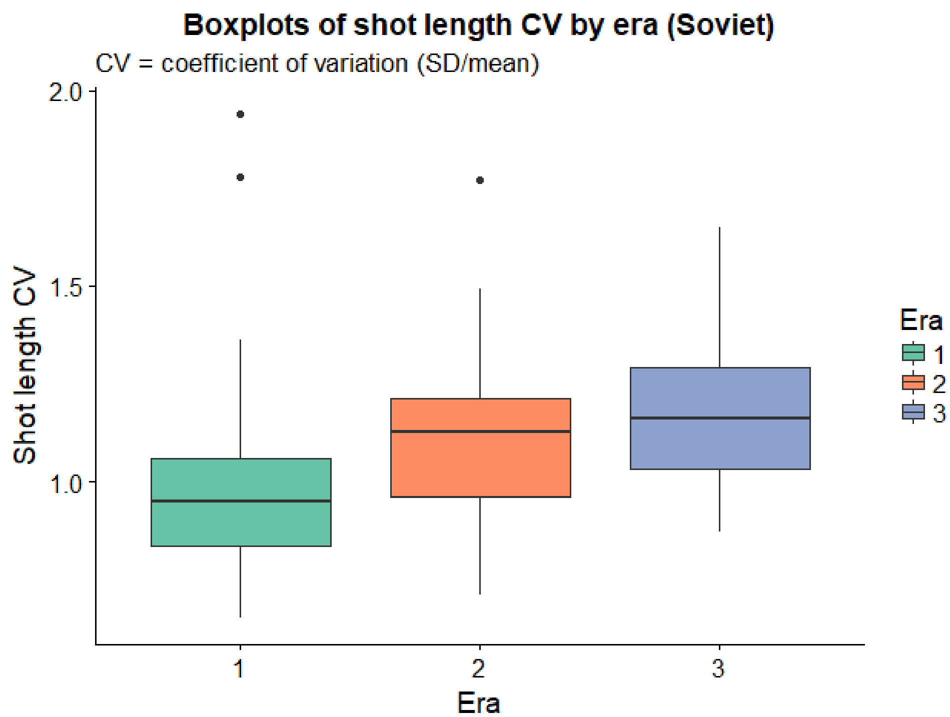

Figure 15. *Shot length coefficient of variation in films in the Soviet Union by era.*

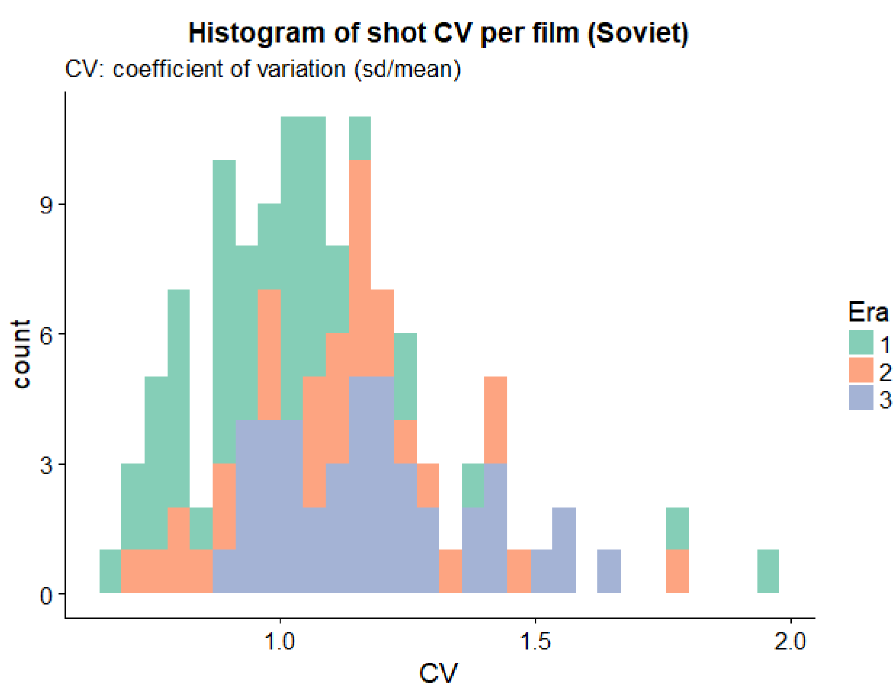

Figure 16. *Histogram of shot length coefficient of variation in films in the Soviet Union by era.*

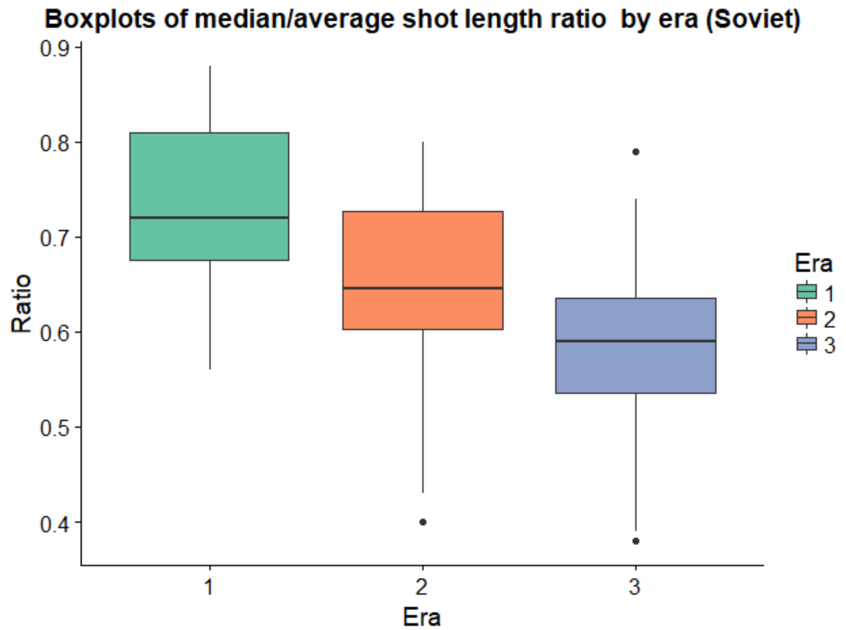

Figure 17. *Ratio of MSL to ASL in films in the Soviet Union by era.*

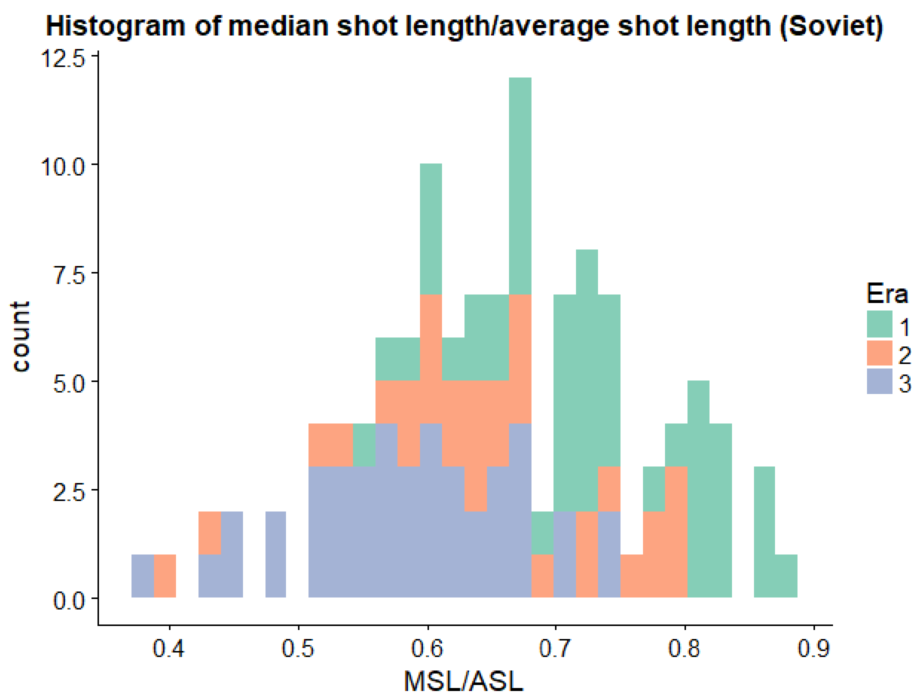

Figure 18. *Histogram of ratio of MSL to ASL in films in the Soviet Union by era.*

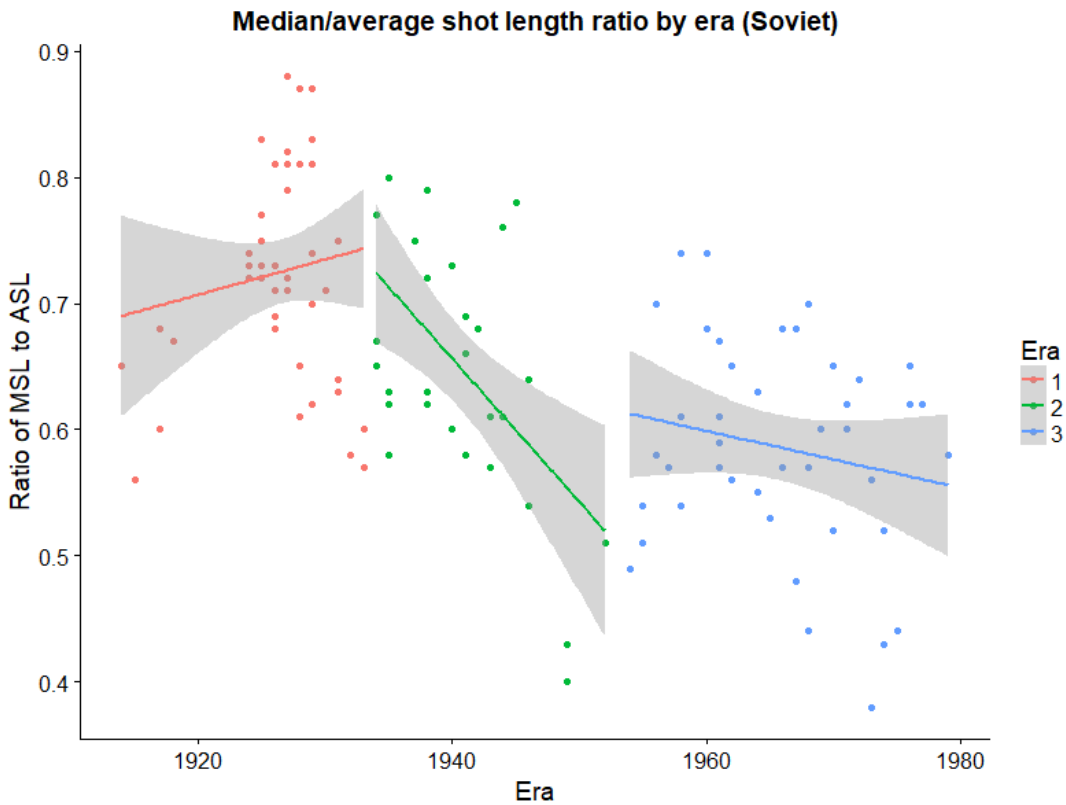

Figure 19. Ratio of MSL to ASL in films in the Soviet Union by era.

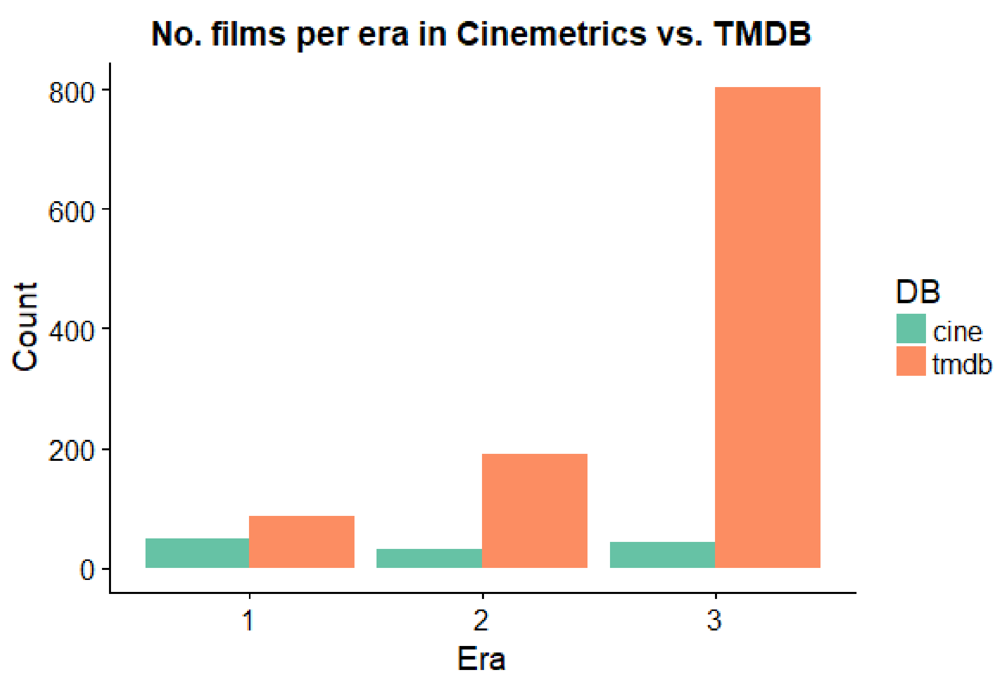

Figure 20. Number of films in the Cinemetrics dataset vs. TMDB dataset per era.

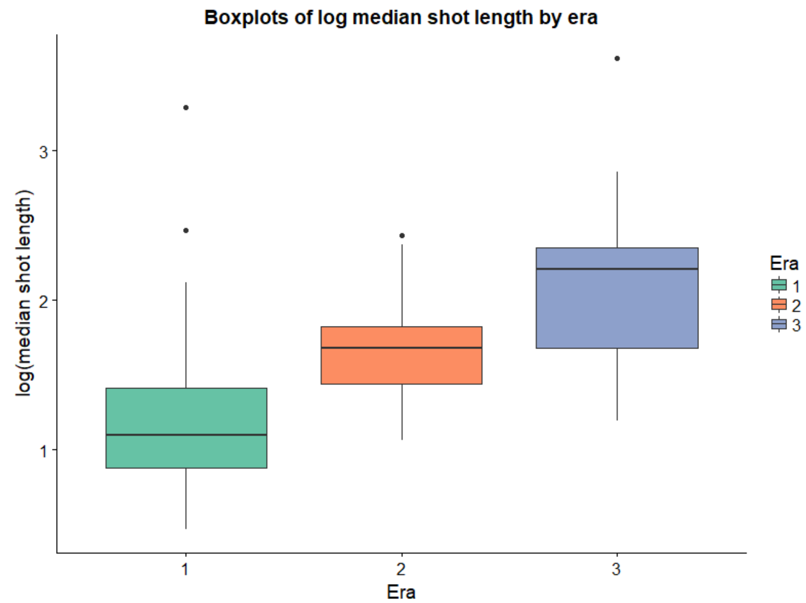

Figure 21. Log of MSL in the Soviet Union by era.

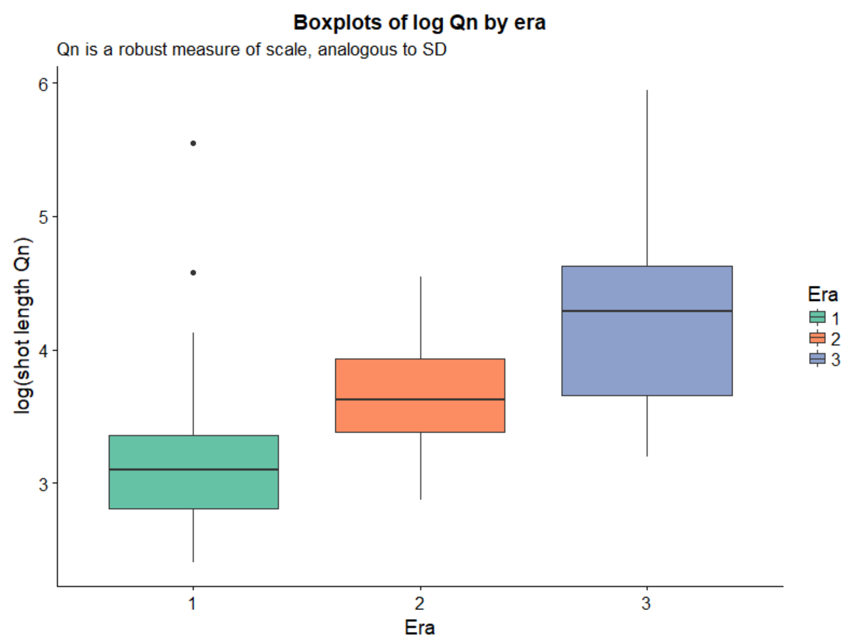

Figure 22. Log of Q_n by era.

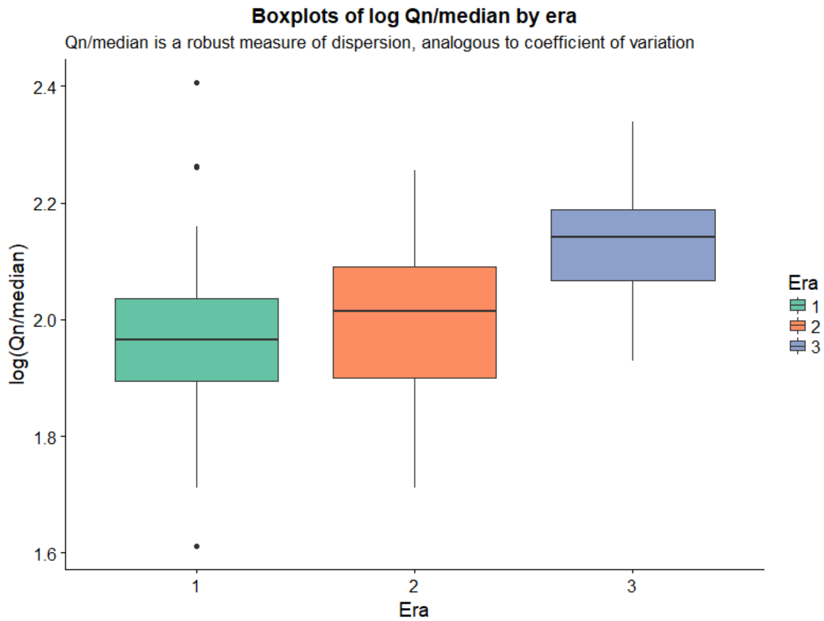

Figure 23. Log of Q_n/MSL by era.