

MSA 2024 Phase 2 - Part 1 Analysis and Preprocessing

```
In [1]: !/opt/anaconda3/bin/python -m pip install xgboost  
!/opt/anaconda3/bin/python -m pip install keras  
!/opt/anaconda3/bin/python -m pip install tensorflow  
!/opt/anaconda3/bin/python -m pip install fbprophet  
!/opt/anaconda3/bin/python -m pip install statsmodels  
import pandas as pd  
import numpy as np  
import matplotlib.pyplot as plt  
%matplotlib inline  
import seaborn as sns  
import sklearn as skl
```

```
Requirement already satisfied: xgboost in /opt/anaconda3/lib/python3.11/site-packages (2.1.0)
Requirement already satisfied: numpy in /opt/anaconda3/lib/python3.11/site-packages (from xgboost) (1.26.4)
Requirement already satisfied: scipy in /opt/anaconda3/lib/python3.11/site-packages (from xgboost) (1.11.4)
Requirement already satisfied: keras in /opt/anaconda3/lib/python3.11/site-packages (3.4.1)
Requirement already satisfied: absl-py in /opt/anaconda3/lib/python3.11/site-packages (from keras) (2.1.0)
Requirement already satisfied: numpy in /opt/anaconda3/lib/python3.11/site-packages (from keras) (1.26.4)
Requirement already satisfied: rich in /opt/anaconda3/lib/python3.11/site-packages (from keras) (13.3.5)
Requirement already satisfied: namex in /opt/anaconda3/lib/python3.11/site-packages (from keras) (0.0.8)
Requirement already satisfied: h5py in /opt/anaconda3/lib/python3.11/site-packages (from keras) (3.11.0)
Requirement already satisfied: optree in /opt/anaconda3/lib/python3.11/site-packages (from keras) (0.12.1)
Requirement already satisfied: ml-dtypes in /opt/anaconda3/lib/python3.11/site-packages (from keras) (0.4.0)
Requirement already satisfied: packaging in /opt/anaconda3/lib/python3.11/site-packages (from keras) (23.1)
Requirement already satisfied: typing-extensions>=4.5.0 in /opt/anaconda3/lib/python3.11/site-packages (from optree->keras) (4.9.0)
Requirement already satisfied: markdown-it-py<3.0.0,>=2.2.0 in /opt/anaconda3/lib/python3.11/site-packages (from rich->keras) (2.2.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /opt/anaconda3/lib/python3.11/site-packages (from rich->keras) (2.15.1)
Requirement already satisfied: mdurl~=0.1 in /opt/anaconda3/lib/python3.11/site-packages (from markdown-it-py<3.0.0,>=2.2.0->rich->keras) (0.1.0)
Requirement already satisfied: tensorflow in /opt/anaconda3/lib/python3.11/site-packages (2.17.0)
Requirement already satisfied: absl-py>=1.0.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (2.1.0)
Requirement already satisfied: astunparse>=1.6.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=24.3.25 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (0.6.0)
Requirement already satisfied: google-pasta>=0.1.1 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (0.2.0)
Requirement already satisfied: h5py>=3.10.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (3.11.0)
Requirement already satisfied: libclang>=13.0.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (18.1.1)
Requirement already satisfied: ml-dtypes<0.5.0,>=0.3.1 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (0.4.0)
Requirement already satisfied: opt-einsum>=2.3.2 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (23.1)
Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3 in /
```

```
opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (3.20.3)
Requirement already satisfied: requests<3,>=2.21.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (2.31.0)
Requirement already satisfied: setuptools in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (68.2.2)
Requirement already satisfied: six>=1.12.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (2.4.0)
Requirement already satisfied: typing-extensions>=3.6.6 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (4.9.0)
Requirement already satisfied: wrapt>=1.11.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (1.14.1)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (1.65.1)
Requirement already satisfied: tensorboard<2.18,>=2.17 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (2.17.0)
Requirement already satisfied: keras>=3.2.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (3.4.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (0.37.1)
Requirement already satisfied: numpy<2.0.0,>=1.23.5 in /opt/anaconda3/lib/python3.11/site-packages (from tensorflow) (1.26.4)
Requirement already satisfied: wheel<1.0,>=0.23.0 in /opt/anaconda3/lib/python3.11/site-packages (from astunparse>=1.6.0->tensorflow) (0.41.2)
Requirement already satisfied: rich in /opt/anaconda3/lib/python3.11/site-packages (from keras>=3.2.0->tensorflow) (13.3.5)
Requirement already satisfied: namex in /opt/anaconda3/lib/python3.11/site-packages (from keras>=3.2.0->tensorflow) (0.0.8)
Requirement already satisfied: optree in /opt/anaconda3/lib/python3.11/site-packages (from keras>=3.2.0->tensorflow) (0.12.1)
Requirement already satisfied: charset-normalizer<4,>=2 in /opt/anaconda3/lib/python3.11/site-packages (from requests<3,>=2.21.0->tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /opt/anaconda3/lib/python3.11/site-packages (from requests<3,>=2.21.0->tensorflow) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in /opt/anaconda3/lib/python3.11/site-packages (from requests<3,>=2.21.0->tensorflow) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in /opt/anaconda3/lib/python3.11/site-packages (from requests<3,>=2.21.0->tensorflow) (2024.2.2)
Requirement already satisfied: markdown>=2.6.8 in /opt/anaconda3/lib/python3.11/site-packages (from tensorboard<2.18,>=2.17->tensorflow) (3.4.1)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /opt/anaconda3/lib/python3.11/site-packages (from tensorboard<2.18,>=2.17->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in /opt/anaconda3/lib/python3.11/site-packages (from tensorboard<2.18,>=2.17->tensorflow) (2.2.2)
```

```
8,>=2.17->tensorflow) (2.2.3)
Requirement already satisfied: MarkupSafe>=2.1.1 in /opt/anaconda3/lib/python3.11/site-packages (from werkzeug>=1.0.
1->tensorboard<2.18,>=2.17->tensorflow) (2.1.3)
Requirement already satisfied: markdown-it-py<3.0.0,>=2.2.0 in /opt/anaconda3/lib/python3.11/site-packages (from ric
h->keras>=3.2.0->tensorflow) (2.2.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /opt/anaconda3/lib/python3.11/site-packages (from rich->ke
ras>=3.2.0->tensorflow) (2.15.1)
Requirement already satisfied: mdurl~0.1 in /opt/anaconda3/lib/python3.11/site-packages (from markdown-it-py<3.0.0,
>=2.2.0->rich->keras>=3.2.0->tensorflow) (0.1.0)
Collecting fbprophet
  Downloading fbprophet-0.7.1.tar.gz (64 kB)
  ━━━━━━━━━━━━━━━━━━━━ 64.0/64.0 kB 2.5 MB/s eta 0:00:00
    Preparing metadata (setup.py) ... done
Collecting Cython>=0.22 (from fbprophet)
  Downloading Cython-3.0.10-py2.py3-none-any.whl.metadata (3.2 kB)
Collecting cmdstanpy==0.9.5 (from fbprophet)
  Downloading cmdstanpy-0.9.5-py3-none-any.whl.metadata (2.9 kB)
Collecting pystan>=2.14 (from fbprophet)
  Downloading pystan-3.10.0-py3-none-any.whl.metadata (3.7 kB)
Requirement already satisfied: numpy>=1.15.4 in /opt/anaconda3/lib/python3.11/site-packages (from fbprophet) (1.26.
4)
Requirement already satisfied: pandas>=1.0.4 in /opt/anaconda3/lib/python3.11/site-packages (from fbprophet) (2.1.4)
Requirement already satisfied: matplotlib>=2.0.0 in /opt/anaconda3/lib/python3.11/site-packages (from fbprophet) (3.
8.0)
Collecting LunarCalendar>=0.0.9 (from fbprophet)
  Downloading LunarCalendar-0.0.9-py2.py3-none-any.whl.metadata (6.3 kB)
Collecting convertdate>=2.1.2 (from fbprophet)
  Downloading convertdate-2.4.0-py3-none-any.whl.metadata (8.3 kB)
Collecting holidays>=0.10.2 (from fbprophet)
  Downloading holidays-0.53-py3-none-any.whl.metadata (23 kB)
Collecting setuptools-git>=1.2 (from fbprophet)
  Downloading setuptools_git-1.2-py2.py3-none-any.whl.metadata (5.8 kB)
Requirement already satisfied: python-dateutil>=2.8.0 in /opt/anaconda3/lib/python3.11/site-packages (from fbproph
e
t) (2.8.2)
Requirement already satisfied: tqdm>=4.36.1 in /opt/anaconda3/lib/python3.11/site-packages (from fbprophet) (4.65.0)
Collecting pymeeus<=1,>=0.3.13 (from convertdate>=2.1.2->fbprophet)
  Downloading PyMeeus-0.5.12.tar.gz (5.8 MB)
  ━━━━━━━━━━━━━━━━ 5.8/5.8 kB 26.5 MB/s eta 0:00:00a 0:00:01
    Preparing metadata (setup.py) ... done
Collecting ephem>=3.7.5.3 (from LunarCalendar>=0.0.9->fbprophet)
  Downloading ephem-4.1.5-cp311-cp311-macosx_11_0_arm64.whl.metadata (6.0 kB)
```

```
Requirement already satisfied: pytz in /opt/anaconda3/lib/python3.11/site-packages (from LunarCalendar>=0.0.9->fbprophet) (2023.3.post1)
Requirement already satisfied: contourpy>=1.0.1 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->fbprophet) (1.2.0)
Requirement already satisfied: cycler>=0.10 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->fbprophet) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->fbprophet) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->fbprophet) (1.4.4)
Requirement already satisfied: packaging>=20.0 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->fbprophet) (23.1)
Requirement already satisfied: pillow>=6.2.0 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->fbprophet) (10.2.0)
Requirement already satisfied: pyparsing>=2.3.1 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->fbprophet) (3.0.9)
Requirement already satisfied: tzdata>=2022.1 in /opt/anaconda3/lib/python3.11/site-packages (from pandas>=1.0.4->fbprophet) (2023.3)
Requirement already satisfied: aiohttp<4.0,>=3.6 in /opt/anaconda3/lib/python3.11/site-packages (from pystan>=2.14->fbprophet) (3.9.3)
Collecting clikit<0.7,>=0.6 (from pystan>=2.14->fbprophet)
  Downloading clikit-0.6.2-py2.py3-none-any.whl.metadata (1.6 kB)
INFO: pip is looking at multiple versions of pystan to determine which version is compatible with other requirements. This could take a while.
Collecting pystan>=2.14 (from fbprophet)
  Downloading pystan-3.9.1-py3-none-any.whl.metadata (3.7 kB)
  Downloading pystan-3.9.0-py3-none-any.whl.metadata (3.7 kB)
  Downloading pystan-3.8.0-py3-none-any.whl.metadata (3.8 kB)
  Downloading pystan-3.7.0-py3-none-any.whl.metadata (3.7 kB)
  Downloading pystan-3.6.0-py3-none-any.whl.metadata (3.7 kB)
  Downloading pystan-3.5.0-py3-none-any.whl.metadata (3.7 kB)
  Downloading pystan-3.4.0-py3-none-any.whl.metadata (3.7 kB)
INFO: pip is still looking at multiple versions of pystan to determine which version is compatible with other requirements. This could take a while.
  Downloading pystan-3.3.0-py3-none-any.whl.metadata (3.6 kB)
  Downloading pystan-3.2.0-py3-none-any.whl.metadata (3.6 kB)
  Downloading pystan-3.1.1-py3-none-any.whl.metadata (3.6 kB)
  Downloading pystan-3.1.0-py3-none-any.whl.metadata (3.6 kB)
  Downloading pystan-3.0.2-py3-none-any.whl.metadata (3.6 kB)
INFO: This is taking longer than usual. You might need to provide the dependency resolver with stricter constraints to reduce runtime. See https://pip.pypa.io/warnings/backtracking for guidance. If you want to abort this run, press
```

```
Ctrl + C.  
  Downloading pystan-3.0.1-py3-none-any.whl.metadata (3.6 kB)  
  Downloading pystan-3.0.0-py3-none-any.whl.metadata (3.6 kB)  
  Downloading pystan-2.19.1.1.tar.gz (16.2 MB)  
          ━━━━━━━━━━━━━━━━ 16.2/16.2 MB 27.6 MB/s eta 0:00:0000:0100:01  
  Preparing metadata (setup.py) ... done  
Requirement already satisfied: six>=1.5 in /opt/anaconda3/lib/python3.11/site-packages (from python-dateutil>=2.8.0->fbprophet) (1.16.0)  
  Downloading cmdstanpy-0.9.5-py3-none-any.whl (37 kB)  
  Downloading convertdate-2.4.0-py3-none-any.whl (47 kB)  
          ━━━━━━━━━━━━ 47.9/47.9 kB 6.4 MB/s eta 0:00:00  
  Downloading Cython-3.0.10-py2.py3-none-any.whl (1.2 MB)  
          ━━━━━━━━━━ 1.2/1.2 MB 24.6 MB/s eta 0:00:00a 0:00:01  
  Downloading holidays-0.53-py3-none-any.whl (1.0 MB)  
          ━━━━━━━━ 1.0/1.0 MB 24.4 MB/s eta 0:00:0000:01  
  Downloading LunarCalendar-0.0.9-py2.py3-none-any.whl (18 kB)  
  Downloading setuptools_git-1.2-py2.py3-none-any.whl (10 kB)  
  Downloading ephem-4.1.5-cp311-cp311-macosx_11_0_arm64.whl (1.4 MB)  
          ━━━━━━ 1.4/1.4 MB 6.6 MB/s eta 0:00:00ta 0:00:01  
Building wheels for collected packages: fbprophet, pystan, pymeeus  
  Building wheel for fbprophet (setup.py) ... error  
error: subprocess-exited-with-error  
  
  × python setup.py bdist_wheel did not run successfully.  
    | exit code: 1  
    | [58 lines of output]  
      /private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b499f2e6e  
e8297e3b9a/setup.py:10: DeprecationWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/e  
n/latest/pkg_resources.html  
      from pkg_resources import (  
      running bdist_wheel  
      running build  
      running build_py  
      creating build  
      creating build/lib  
      creating build/lib/fbprophet  
      creating build/lib/fbprophet/stan_model  
      NumExpr defaulting to 8 threads.  
      Traceback (most recent call last):  
        File "<string>", line 2, in <module>  
        File "<pip-setuptools-caller>", line 34, in <module>
```

```
File "/private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b
499f2e6ee8297e3b9a/setup.py", line 122, in <module>
    setup(
      File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/__init__.py", line 103, in setup
        return distutils.core.setup(**attrs)
               ~~~~~
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/core.py", line 185, in setup
    return run_commands(dist)
           ~~~~~
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/core.py", line 201, in run_commands
    dist.run_commands()
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/dist.py", line 969, in run_commands
    self.run_command(cmd)
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/dist.py", line 989, in run_command
    super().run_command(command)
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/dist.py", line 988, in run_command
    cmd_obj.run()
File "/opt/anaconda3/lib/python3.11/site-packages/wheel/bdist_wheel.py", line 364, in run
    self.run_command("build")
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/cmd.py", line 318, in run_command
    self.distribution.run_command(command)
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/dist.py", line 989, in run_command
    super().run_command(command)
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/dist.py", line 988, in run_command
    cmd_obj.run()
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/command/build.py", line 131, in run
    self.run_command(cmd_name)
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/cmd.py", line 318, in run_command
    self.distribution.run_command(command)
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/dist.py", line 989, in run_command
    super().run_command(command)
File "/opt/anaconda3/lib/python3.11/site-packages/setuptools/_distutils/dist.py", line 988, in run_command
    cmd_obj.run()
File "/private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b
499f2e6ee8297e3b9a/setup.py", line 48, in run
    build_models(target_dir)
File "/private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b
499f2e6ee8297e3b9a/setup.py", line 36, in build_models
    from fbprophet.models import StanBackendEnum
File "/private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b
499f2e6ee8297e3b9a/fbprophet/__init__.py", line 8, in <module>
```

```
    from fbprophet.forecaster import Prophet
    File "/private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b
499f2e6ee8297e3b9a/fbprophet/forecaster.py", line 17, in <module>
        from fbprophet.make_holidays import get_holiday_names, make_holidays_df
    File "/private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b
499f2e6ee8297e3b9a/fbprophet/make_holidays.py", line 14, in <module>
            import fbprophet.hdays as hdays_part2
    File "/private/var/folders/py/dcf2v97n7vvfxh73_ps7qd9r0000gn/T/pip-install-2kkywzg2/fbprophet_5ce356b7c2554b
499f2e6ee8297e3b9a/fbprophet/hdays.py", line 13, in <module>
            from convertdate.islamic import from_gregorian, to_gregorian
ModuleNotFoundError: No module named 'convertdate'
[end of output]
```

note: This error originates from a subprocess, and is likely not a problem with pip.

ERROR: Failed building wheel for fbprophet

Running setup.py clean for fbprophet

Building wheel for pystan (setup.py) ... error

error: subprocess-exited-with-error

x python setup.py bdist_wheel did not run successfully.

exit code: 1

[1 lines of output]

Cython>=0.22 and NumPy are required.

[end of output]

note: This error originates from a subprocess, and is likely not a problem with pip.

ERROR: Failed building wheel for pystan

Running setup.py clean for pystan

Building wheel for pymeeus (setup.py) ... done

Created wheel for pymeeus: filename=PyMeeus-0.5.12-py3-none-any.whl size=732000 sha256=d8794ed3a0d458037f18959c882
80bc2c6c0ae49581c84875456e91f3a7a128d

Stored in directory: /Users/liufang/Library/Caches/pip/wheels/8f/bd/f9/5c4c39b529e0322b08979e1c465e203218bc2cca75d
20f7df5

Successfully built pymeeus

Failed to build fbprophet pystan

ERROR: Could not build wheels for fbprophet, pystan, which is required to install pyproject.toml-based projects

Requirement already satisfied: statsmodels in /opt/anaconda3/lib/python3.11/site-packages (0.14.0)

Requirement already satisfied: numpy>=1.18 in /opt/anaconda3/lib/python3.11/site-packages (from statsmodels) (1.26.
4)

Requirement already satisfied: scipy!=1.9.2,>=1.4 in /opt/anaconda3/lib/python3.11/site-packages (from statsmodels)
(1.11.4)

```
Requirement already satisfied: pandas>=1.0 in /opt/anaconda3/lib/python3.11/site-packages (from statsmodels) (2.1.4)
Requirement already satisfied: patsy>=0.5.2 in /opt/anaconda3/lib/python3.11/site-packages (from statsmodels) (0.5.3)
Requirement already satisfied: packaging>=21.3 in /opt/anaconda3/lib/python3.11/site-packages (from statsmodels) (2.3.1)
Requirement already satisfied: python-dateutil>=2.8.2 in /opt/anaconda3/lib/python3.11/site-packages (from pandas>=1.0->statsmodels) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /opt/anaconda3/lib/python3.11/site-packages (from pandas>=1.0->statsmodels) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in /opt/anaconda3/lib/python3.11/site-packages (from pandas>=1.0->statsmodels) (2023.3)
Requirement already satisfied: six in /opt/anaconda3/lib/python3.11/site-packages (from patsy>=0.5.2->statsmodels) (1.16.0)
```

1. Find all variables and understand them

```
In [2]: # Choose W Store Sales as the dataset and merged the three tables
url_features="https://raw.githubusercontent.com/NZMSA/2024-Phase-2/main/data-science/0.%20Resources/datasets/W%20store%20features.csv"
df_features=pd.read_csv(url_features)
df_features.info()

url_sales="https://raw.githubusercontent.com/NZMSA/2024-Phase-2/main/data-science/0.%20Resources/datasets/W%20store%20sales.csv"
df_sales=pd.read_csv(url_sales)
df_sales.info()

url_stores="https://raw.githubusercontent.com/NZMSA/2024-Phase-2/main/data-science/0.%20Resources/datasets/W%20stores.csv"
df_stores=pd.read_csv(url_stores)
df_stores.info()

# Merging the three tables by the unique keys
merged_data=pd.merge(df_sales, df_features, on=['Store', 'Date', 'IsHoliday'], how='left')
merged_data=pd.merge(merged_data, df_stores, on='Store', how='left')

merged_data=merged_data.sort_values(by=['Store', 'Dept', 'Date'])
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8190 entries, 0 to 8189
Data columns (total 12 columns):
 #   Column      Non-Null Count  Dtype  
--- 
 0   Store        8190 non-null    int64  
 1   Date         8190 non-null    object  
 2   Temperature  8190 non-null    float64 
 3   Fuel_Price   8190 non-null    float64 
 4   MarkDown1   4032 non-null    float64 
 5   MarkDown2   2921 non-null    float64 
 6   MarkDown3   3613 non-null    float64 
 7   MarkDown4   3464 non-null    float64 
 8   MarkDown5   4050 non-null    float64 
 9   CPI          7605 non-null    float64 
 10  Unemployment 7605 non-null    float64 
 11  IsHoliday    8190 non-null    bool    
dtypes: bool(1), float64(9), int64(1), object(1)
memory usage: 712.0+ KB
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 421570 entries, 0 to 421569
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype  
--- 
 0   Store        421570 non-null    int64  
 1   Dept         421570 non-null    int64  
 2   Date         421570 non-null    object  
 3   Weekly_Sales 421570 non-null    float64 
 4   IsHoliday    421570 non-null    bool    
dtypes: bool(1), float64(1), int64(2), object(1)
memory usage: 13.3+ MB
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 45 entries, 0 to 44
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype  
--- 
 0   Store    45 non-null    int64  
 1   Type     45 non-null    object  
 2   Size     45 non-null    int64  
dtypes: int64(2), object(1)
memory usage: 1.2+ KB
```

2. Setting the labels and the distribution of values in columns

```
In [14]: #setting the following 12 weekly sales as labels
for i in range(1,13):
    merged_data[f'Weekly_Sales_{i+1}w']=merged_data.groupby(['Store','Dept'])['Weekly_Sales'].shift(-i)
print("The number of rows before data processing:", merged_data.shape[0])
merged_data=merged_data.dropna(subset=['Weekly_Sales_13w'])
print("The number of rows after data processing:", merged_data.shape[0])

# the distribution of values in columns
merged_data.info()
merged_selected_types=merged_data.select_dtypes(include=['float64', 'int64'])
mean=merged_selected_types.mean()
variance=merged_selected_types.var()
std=merged_selected_types.std()
quantiles=merged_selected_types.quantile([0,0.05,0.25,0.5,0.75,0.90,0.95,0.96,0.97,0.98,0.99,1])
print(f"\n Mean:{ mean} \n Variance :{variance} \n Standard deviation:{std} \n Quantiles:{quantiles}\n")

plt.figure(figsize=(10,6))
sns.heatmap(merged_selected_types.isnull(),cbar=False, cmap='viridis', yticklabels=False)
plt.title('Missing Values Heatmap in Merged Data')
plt.show()
```

The number of rows before data processing: 382955
The number of rows after data processing: 345774
<class 'pandas.core.frame.DataFrame'>
Index: 345774 entries, 0 to 421545
Data columns (total 28 columns):

#	Column	Non-Null Count	Dtype
0	Store	345774 non-null	int64
1	Dept	345774 non-null	int64
2	Date	345774 non-null	object
3	Weekly_Sales	345774 non-null	float64
4	IsHoliday	345774 non-null	bool
5	Temperature	345774 non-null	float64
6	Fuel_Price	345774 non-null	float64
7	MarkDown1	77753 non-null	float64
8	MarkDown2	64944 non-null	float64
9	MarkDown3	72286 non-null	float64
10	MarkDown4	69783 non-null	float64
11	MarkDown5	78076 non-null	float64
12	CPI	345774 non-null	float64
13	Unemployment	345774 non-null	float64
14	Type	345774 non-null	object
15	Size	345774 non-null	int64
16	Weekly_Sales_2w	345774 non-null	float64
17	Weekly_Sales_3w	345774 non-null	float64
18	Weekly_Sales_4w	345774 non-null	float64
19	Weekly_Sales_5w	345774 non-null	float64
20	Weekly_Sales_6w	345774 non-null	float64
21	Weekly_Sales_7w	345774 non-null	float64
22	Weekly_Sales_8w	345774 non-null	float64
23	Weekly_Sales_9w	345774 non-null	float64
24	Weekly_Sales_10w	345774 non-null	float64
25	Weekly_Sales_11w	345774 non-null	float64
26	Weekly_Sales_12w	345774 non-null	float64
27	Weekly_Sales_13w	345774 non-null	float64

dtypes: bool(1), float64(22), int64(3), object(2)
memory usage: 74.2+ MB

Mean:

Store	22.158766
Dept	44.147197

```
Weekly_Sales      16228.497898
Temperature       57.511481
Fuel_Price        3.286738
MarkDown1         7681.838259
MarkDown2         5523.082296
MarkDown3         2622.474853
MarkDown4         3847.396952
MarkDown5         4747.041181
CPI               170.291247
Unemployment     8.109090
Size              137088.942289
Weekly_Sales_2w   16220.351465
Weekly_Sales_3w   16219.446272
Weekly_Sales_4w   16219.749520
Weekly_Sales_5w   16236.394036
Weekly_Sales_6w   16240.977210
Weekly_Sales_7w   16246.154807
Weekly_Sales_8w   16250.827438
Weekly_Sales_9w   16271.310608
Weekly_Sales_10w  16258.725940
Weekly_Sales_11w  16254.835083
Weekly_Sales_12w  16251.542364
Weekly_Sales_13w  16259.257373
dtype: float64
Variance :
Store            1.632305e+02
Dept              9.336180e+02
Weekly_Sales      5.258660e+08
Temperature       3.454727e+02
Fuel_Price        2.092680e-01
MarkDown1         9.159178e+07
MarkDown2         1.397754e+08
MarkDown3         1.689763e+08
MarkDown4         6.284497e+07
MarkDown5         2.428025e+07
CPI               1.504059e+03
Unemployment     3.480700e+00
Size              3.701148e+09
Weekly_Sales_2w   5.244526e+08
Weekly_Sales_3w   5.241898e+08
Weekly_Sales_4w   5.239966e+08
```

```

Weekly_Sales_5w      5.247724e+08
Weekly_Sales_6w      5.246751e+08
Weekly_Sales_7w      5.245236e+08
Weekly_Sales_8w      5.247602e+08
Weekly_Sales_9w      5.261532e+08
Weekly_Sales_10w     5.256858e+08
Weekly_Sales_11w     5.257251e+08
Weekly_Sales_12w     5.254448e+08
Weekly_Sales_13w     5.260037e+08
dtype: float64

```

Standard deviation:

Store	12.776171
Dept	30.555164
Weekly_Sales	22931.768540
Temperature	18.586895
Fuel_Price	0.457458
MarkDown1	9570.359378
MarkDown2	11822.665829
MarkDown3	12999.089172
MarkDown4	7927.481812
MarkDown5	4927.499172
CPI	38.782201
Unemployment	1.865664
Size	60837.061225
Weekly_Sales_2w	22900.930839
Weekly_Sales_3w	22895.192073
Weekly_Sales_4w	22890.971901
Weekly_Sales_5w	22907.911694
Weekly_Sales_6w	22905.787756
Weekly_Sales_7w	22902.479543
Weekly_Sales_8w	22907.645303
Weekly_Sales_9w	22938.030006
Weekly_Sales_10w	22927.838618
Weekly_Sales_11w	22928.695086
Weekly_Sales_12w	22922.582309
Weekly_Sales_13w	22934.770844

dtype: float64

Quantiles:

	Store	Dept	Weekly_Sales	Temperature	Fuel_Price	MarkDown1	\
0.00	1.0	1.0	-4988.9400	-2.06	2.472	0.50	
0.05	3.0	4.0	90.5000	25.90	2.635	98.84	

0.25	11.0	18.0	2259.0050	44.04	2.846	2021.51
0.50	22.0	37.0	7850.8650	58.21	3.274	5183.29
0.75	33.0	74.0	20458.0700	71.39	3.684	9582.27
0.90	40.0	91.0	43137.8410	82.30	3.891	16514.65
0.95	43.0	95.0	61657.8390	86.84	3.989	23811.41
0.96	43.0	96.0	67847.8472	87.83	4.025	26115.19
0.97	44.0	96.0	75415.6188	89.16	4.061	32124.49
0.98	45.0	97.0	86258.1810	90.45	4.117	36848.38
0.99	45.0	98.0	107743.3199	92.07	4.192	51879.66
1.00	45.0	99.0	693099.3600	100.14	4.294	88646.76

	MarkDown2	MarkDown3	MarkDown4	MarkDown5	...	Weekly_Sales_4w	\
0.00	-265.76	-1.00	0.46	135.16	...	-4988.9400	
0.05	2.50	1.04	17.64	653.02	...	90.5265	
0.25	96.90	6.14	384.78	1869.98	...	2260.5950	
0.50	1050.48	37.38	1204.70	3413.90	...	7836.6550	
0.75	5524.49	190.30	3639.42	5793.48	...	20468.6950	
0.90	14273.24	959.55	9381.13	9198.59	...	43170.1370	
0.95	26833.97	2885.14	16024.01	14073.59	...	61608.6640	
0.96	33378.79	9191.67	18849.21	15694.32	...	67775.0080	
0.97	38677.72	40362.07	28199.34	17861.50	...	75320.9570	
0.98	49826.06	61319.72	35785.26	23235.01	...	85917.2662	
0.99	56106.20	77126.16	46238.28	28238.93	...	107433.9061	
1.00	104519.54	141630.61	67474.85	37581.27	...	693099.3600	

	Weekly_Sales_5w	Weekly_Sales_6w	Weekly_Sales_7w	Weekly_Sales_8w	\
0.00	-4988.9400	-4988.9400	-4988.9400	-4988.9400	
0.05	90.7600	90.6565	90.2500	90.0000	
0.25	2263.3075	2264.9025	2266.0525	2264.5425	
0.50	7843.2900	7843.8300	7843.5800	7838.8150	
0.75	20495.9550	20510.3750	20530.2875	20549.7475	
0.90	43227.8200	43240.6270	43265.4090	43282.8190	
0.95	61657.6710	61671.8095	61658.3980	61657.6710	
0.96	67829.1724	67827.3248	67827.3248	67829.4648	
0.97	75358.7736	75358.7736	75334.6598	75347.9058	
0.98	85959.5858	85900.9188	85841.8590	85841.8590	
0.99	107458.3920	107338.8630	107247.6568	107310.4945	
1.00	693099.3600	693099.3600	693099.3600	693099.3600	

	Weekly_Sales_9w	Weekly_Sales_10w	Weekly_Sales_11w	Weekly_Sales_12w	\
0.00	-4988.9400	-4988.9400	-4988.9400	-4988.9400	

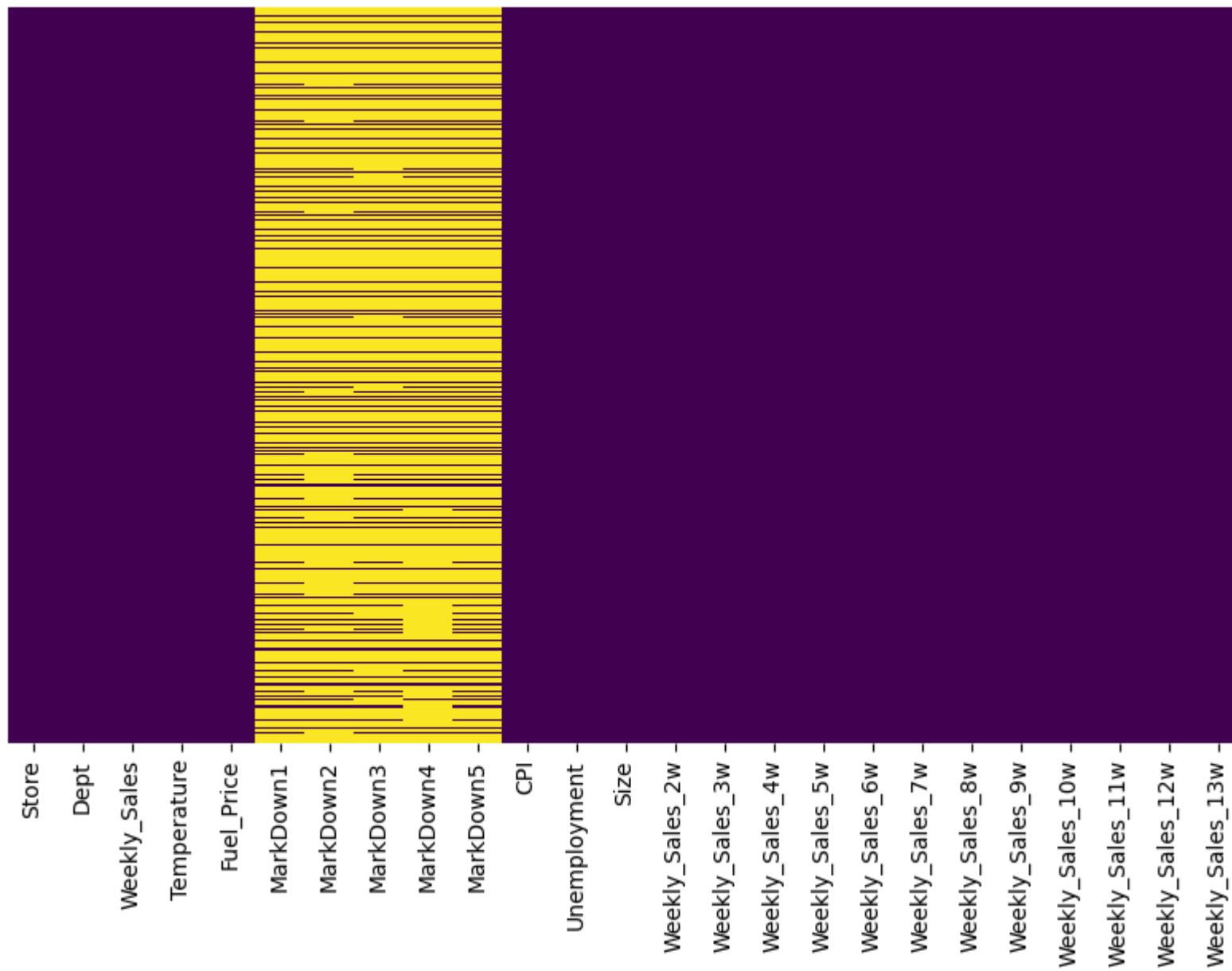
0.05	90.0000	89.8265	89.4730	88.8265
0.25	2263.5750	2258.9725	2255.0000	2253.1475
0.50	7843.0050	7831.0750	7827.3250	7824.5250
0.75	20581.0100	20568.9225	20565.4725	20570.2975
0.90	43357.3350	43319.8890	43307.2490	43295.8800
0.95	61745.0790	61701.3185	61695.6320	61671.8095
0.96	67904.1704	67861.6696	67864.0100	67851.7536
0.97	75433.0933	75385.4443	75395.9936	75365.3243
0.98	85922.3286	85900.9188	85886.3524	85855.6074
0.99	107424.1719	107277.2554	107277.2554	107188.6517
1.00	693099.3600	693099.3600	693099.3600	693099.3600

Weekly_Sales_13w

0.00	-4988.9400
0.05	88.3100
0.25	2251.3050
0.50	7824.1500
0.75	20586.0275
0.90	43316.1020
0.95	61698.1385
0.96	67880.5912
0.97	75415.6188
0.98	85910.6370
0.99	107338.8630
1.00	693099.3600

[12 rows x 25 columns]

Missing Values Heatmap in Merged Data



3. Clean data

In [16]:

```
#Data cleaning
# Consider the solution to process the missing values in columns
for i in range(1, 6):
    print(f"the number of 0 in Markdown{i} is: {(merged_data[f'Markdown{i}'] == 0).sum()}")
# Considering that the proportion of missing values in columns Markdown1-5 exceeds 70%, and there are valid values
# in order to avoid unexpected impacts on the model results, these columns will not be considered as input variable
# in the subsequent modeling process.

#Transferring the bool variable into numeric
merged_data['IsHoliday']=merged_data['IsHoliday'].astype(int)
# Convert "Type" to numeric type, create a mapping dictionary, and use the map method to convert the type to integer
type_mapping = {'A': 0, 'B': 1, 'C': 2}
merged_data['Type'] = merged_data['Type'].map(type_mapping)
# to avoid the influence of outliers in y labels, we drop the values which are larger than 90% quantile and smaller
data_frames = {} # Used to store processed dataframes
for i in range(2,14):
    quantile_10 = merged_data[f'Weekly_Sales_{i}w'].quantile(0.10)
    quantile_90 = merged_data[f'Weekly_Sales_{i}w'].quantile(0.90)
    filtered_data = merged_data[(merged_data[f'Weekly_Sales_{i}w'] >= quantile_10) & (merged_data[f'Weekly_Sales_{i}w'] <= quantile_90)]
    # Delete sales data for other weeks, ensuring that there is only one y label at a time
    cols_to_keep = [col for col in filtered_data.columns if col == f'Weekly_Sales_{i}w' or 'Weekly_Sales_' not in col]
    filtered_data = filtered_data[cols_to_keep]
    data_frames[f'Weekly_Sales_{i}w'] = filtered_data

for week, df in data_frames.items():
    print(f"Number of rows retained for {week}:\n {df.info()} ")
```

```
the number of 0 in MarkDown1 is: 0
the number of 0 in MarkDown2 is: 65
the number of 0 in MarkDown3 is: 0
the number of 0 in MarkDown4 is: 0
the number of 0 in MarkDown5 is: 0
<class 'pandas.core.frame.DataFrame'>
Index: 276618 entries, 1 to 421545
Data columns (total 17 columns):
 #   Column            Non-Null Count  Dtype  
--- 
 0   Store              276618 non-null   int64  
 1   Dept               276618 non-null   int64  
 2   Date               276618 non-null   object  
 3   Weekly_Sales       276618 non-null   float64 
 4   IsHoliday          276618 non-null   int64  
 5   Temperature        276618 non-null   float64 
 6   Fuel_Price         276618 non-null   float64 
 7   MarkDown1          62554  non-null    float64 
 8   MarkDown2          52449  non-null    float64 
 9   MarkDown3          58378  non-null    float64 
 10  MarkDown4          57526  non-null    float64 
 11  MarkDown5          62761  non-null    float64 
 12  CPI                276618 non-null   float64 
 13  Unemployment      276618 non-null   float64 
 14  Type               276618 non-null   int64  
 15  Size               276618 non-null   int64  
 16  Weekly_Sales_2w   276618 non-null   float64 
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_2w:

None

```
<class 'pandas.core.frame.DataFrame'>
Index: 276618 entries, 0 to 421545
Data columns (total 17 columns):
 #   Column            Non-Null Count  Dtype  
--- 
 0   Store              276618 non-null   int64  
 1   Dept               276618 non-null   int64  
 2   Date               276618 non-null   object  
 3   Weekly_Sales       276618 non-null   float64 
 4   IsHoliday          276618 non-null   int64 
```

```
5   Temperature      276618 non-null  float64
6   Fuel_Price       276618 non-null  float64
7   MarkDown1        62504  non-null   float64
8   MarkDown2        52458  non-null   float64
9   MarkDown3        58299  non-null   float64
10  MarkDown4        57465  non-null   float64
11  MarkDown5        62714  non-null   float64
12  CPI              276618 non-null  float64
13  Unemployment    276618 non-null  float64
14  Type             276618 non-null  int64
15  Size             276618 non-null  int64
16  Weekly_Sales_3w  276618 non-null  float64
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_3w:

None

<class 'pandas.core.frame.DataFrame'>

Index: 276618 entries, 0 to 421545

Data columns (total 17 columns):

#	Column	Non-Null Count	Dtype
0	Store	276618 non-null	int64
1	Dept	276618 non-null	int64
2	Date	276618 non-null	object
3	Weekly_Sales	276618 non-null	float64
4	IsHoliday	276618 non-null	int64
5	Temperature	276618 non-null	float64
6	Fuel_Price	276618 non-null	float64
7	MarkDown1	62537 non-null	float64
8	MarkDown2	52531 non-null	float64
9	MarkDown3	58331 non-null	float64
10	MarkDown4	57499 non-null	float64
11	MarkDown5	62741 non-null	float64
12	CPI	276618 non-null	float64
13	Unemployment	276618 non-null	float64
14	Type	276618 non-null	int64
15	Size	276618 non-null	int64
16	Weekly_Sales_4w	276618 non-null	float64

```
dtypes: float64(11), int64(5), object(1)
```

memory usage: 38.0+ MB

Number of rows retained for Weekly_Sales_4w:

```
None
<class 'pandas.core.frame.DataFrame'>
Index: 276618 entries, 0 to 421545
Data columns (total 17 columns):
 #   Column            Non-Null Count  Dtype  
--- 
 0   Store              276618 non-null   int64  
 1   Dept               276618 non-null   int64  
 2   Date               276618 non-null   object  
 3   Weekly_Sales       276618 non-null   float64 
 4   IsHoliday          276618 non-null   int64  
 5   Temperature        276618 non-null   float64 
 6   Fuel_Price          276618 non-null   float64 
 7   MarkDown1           62491 non-null    float64 
 8   MarkDown2           52538 non-null    float64 
 9   MarkDown3           58268 non-null    float64 
 10  MarkDown4          57449 non-null    float64 
 11  MarkDown5          62689 non-null    float64 
 12  CPI                276618 non-null   float64 
 13  Unemployment       276618 non-null   float64 
 14  Type               276618 non-null   int64  
 15  Size               276618 non-null   int64  
 16  Weekly_Sales_5w    276618 non-null   float64 
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_5w:

```
None
<class 'pandas.core.frame.DataFrame'>
Index: 276623 entries, 0 to 421545
Data columns (total 17 columns):
 #   Column            Non-Null Count  Dtype  
--- 
 0   Store              276623 non-null   int64  
 1   Dept               276623 non-null   int64  
 2   Date               276623 non-null   object  
 3   Weekly_Sales       276623 non-null   float64 
 4   IsHoliday          276623 non-null   int64  
 5   Temperature        276623 non-null   float64 
 6   Fuel_Price          276623 non-null   float64 
 7   MarkDown1           62484 non-null    float64 
 8   MarkDown2           52478 non-null    float64
```

```
9  MarkDown3      58256 non-null  float64
10 MarkDown4      57449 non-null  float64
11 MarkDown5      62679 non-null  float64
12 CPI           276623 non-null  float64
13 Unemployment   276623 non-null  float64
14 Type          276623 non-null  int64
15 Size          276623 non-null  int64
16 Weekly_Sales_6w 276623 non-null  float64
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_6w:

```
None
<class 'pandas.core.frame.DataFrame'>
Index: 276618 entries, 0 to 421545
Data columns (total 17 columns):
 #  Column          Non-Null Count  Dtype  
--- 
 0  Store           276618 non-null   int64  
 1  Dept            276618 non-null   int64  
 2  Date            276618 non-null   object  
 3  Weekly_Sales    276618 non-null   float64 
 4  IsHoliday       276618 non-null   int64  
 5  Temperature     276618 non-null   float64 
 6  Fuel_Price      276618 non-null   float64 
 7  MarkDown1       62500 non-null    float64 
 8  MarkDown2       52514 non-null    float64 
 9  MarkDown3       58273 non-null    float64 
 10 MarkDown4      57474 non-null    float64 
 11 MarkDown5       62695 non-null    float64 
 12 CPI            276618 non-null   float64 
 13 Unemployment   276618 non-null   float64 
 14 Type           276618 non-null   int64  
 15 Size           276618 non-null   int64  
 16 Weekly_Sales_7w 276618 non-null   float64
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_7w:

```
None
<class 'pandas.core.frame.DataFrame'>
Index: 276618 entries, 0 to 421545
Data columns (total 17 columns):
```

#	Column	Non-Null Count	Dtype	
0	Store	276618	non-null	int64
1	Dept	276618	non-null	int64
2	Date	276618	non-null	object
3	Weekly_Sales	276618	non-null	float64
4	IsHoliday	276618	non-null	int64
5	Temperature	276618	non-null	float64
6	Fuel_Price	276618	non-null	float64
7	MarkDown1	62645	non-null	float64
8	MarkDown2	52670	non-null	float64
9	MarkDown3	58426	non-null	float64
10	MarkDown4	57631	non-null	float64
11	MarkDown5	62843	non-null	float64
12	CPI	276618	non-null	float64
13	Unemployment	276618	non-null	float64
14	Type	276618	non-null	int64
15	Size	276618	non-null	int64
16	Weekly_Sales_8w	276618	non-null	float64

dtypes: float64(11), int64(5), object(1)

memory usage: 38.0+ MB

Number of rows retained for Weekly_Sales_8w:

None

<class 'pandas.core.frame.DataFrame'>

Index: 276620 entries, 1 to 421545

Data columns (total 17 columns):

#	Column	Non-Null Count	Dtype	
0	Store	276620	non-null	int64
1	Dept	276620	non-null	int64
2	Date	276620	non-null	object
3	Weekly_Sales	276620	non-null	float64
4	IsHoliday	276620	non-null	int64
5	Temperature	276620	non-null	float64
6	Fuel_Price	276620	non-null	float64
7	MarkDown1	62551	non-null	float64
8	MarkDown2	52607	non-null	float64
9	MarkDown3	58348	non-null	float64
10	MarkDown4	57543	non-null	float64
11	MarkDown5	62748	non-null	float64
12	CPI	276620	non-null	float64

```
13 Unemployment    276620 non-null  float64
14 Type            276620 non-null  int64
15 Size            276620 non-null  int64
16 Weekly_Sales_9w 276620 non-null  float64
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_9w:

```
None
<class 'pandas.core.frame.DataFrame'>
Index: 276618 entries, 0 to 421545
```

Data columns (total 17 columns):

#	Column	Non-Null Count	Dtype
0	Store	276618	non-null int64
1	Dept	276618	non-null int64
2	Date	276618	non-null object
3	Weekly_Sales	276618	non-null float64
4	IsHoliday	276618	non-null int64
5	Temperature	276618	non-null float64
6	Fuel_Price	276618	non-null float64
7	MarkDown1	62500	non-null float64
8	MarkDown2	52529	non-null float64
9	MarkDown3	58294	non-null float64
10	MarkDown4	57479	non-null float64
11	MarkDown5	62700	non-null float64
12	CPI	276618	non-null float64
13	Unemployment	276618	non-null float64
14	Type	276618	non-null int64
15	Size	276618	non-null int64
16	Weekly_Sales_10w	276618	non-null float64

```
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_10w:

```
None
<class 'pandas.core.frame.DataFrame'>
Index: 276620 entries, 0 to 421545
```

Data columns (total 17 columns):

#	Column	Non-Null Count	Dtype
0	Store	276620	non-null int64
1	Dept	276620	non-null int64

```
2 Date 276620 non-null object
3 Weekly_Sales 276620 non-null float64
4 IsHoliday 276620 non-null int64
5 Temperature 276620 non-null float64
6 Fuel_Price 276620 non-null float64
7 MarkDown1 62469 non-null float64
8 MarkDown2 52453 non-null float64
9 MarkDown3 58292 non-null float64
10 MarkDown4 57435 non-null float64
11 MarkDown5 62671 non-null float64
12 CPI 276620 non-null float64
13 Unemployment 276620 non-null float64
14 Type 276620 non-null int64
15 Size 276620 non-null int64
16 Weekly_Sales_11w 276620 non-null float64
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
```

Number of rows retained for Weekly_Sales_11w:

None

<class 'pandas.core.frame.DataFrame'>

Index: 276618 entries, 0 to 421545

Data columns (total 17 columns):

#	Column	Non-Null Count	Dtype
0	Store	276618	non-null int64
1	Dept	276618	non-null int64
2	Date	276618	non-null object
3	Weekly_Sales	276618	non-null float64
4	IsHoliday	276618	non-null int64
5	Temperature	276618	non-null float64
6	Fuel_Price	276618	non-null float64
7	MarkDown1	62440	non-null float64
8	MarkDown2	52413	non-null float64
9	MarkDown3	58247	non-null float64
10	MarkDown4	57388	non-null float64
11	MarkDown5	62638	non-null float64
12	CPI	276618	non-null float64
13	Unemployment	276618	non-null float64
14	Type	276618	non-null int64
15	Size	276618	non-null int64
16	Weekly_Sales_12w	276618	non-null float64

```
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
Number of rows retained for Weekly_Sales_12w:
None
<class 'pandas.core.frame.DataFrame'>
Index: 276618 entries, 0 to 421545
Data columns (total 17 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   Store            276618 non-null   int64  
 1   Dept             276618 non-null   int64  
 2   Date             276618 non-null   object  
 3   Weekly_Sales     276618 non-null   float64 
 4   IsHoliday        276618 non-null   int64  
 5   Temperature      276618 non-null   float64 
 6   Fuel_Price       276618 non-null   float64 
 7   MarkDown1        62359  non-null    float64 
 8   MarkDown2        52346  non-null    float64 
 9   MarkDown3        58163  non-null    float64 
 10  MarkDown4       57307  non-null    float64 
 11  MarkDown5       62558  non-null    float64 
 12  CPI              276618 non-null   float64 
 13  Unemployment    276618 non-null   float64 
 14  Type             276618 non-null   int64  
 15  Size             276618 non-null   int64  
 16  Weekly_Sales_13w 276618 non-null   float64 
dtypes: float64(11), int64(5), object(1)
memory usage: 38.0+ MB
Number of rows retained for Weekly_Sales_13w:
None
```

4. Visualise data

```
In [18]: # Draw the histograms and box graphics to show the distribution of values and outliers intuitively and directly
# Set the style of graphics
sns.set(style="whitegrid")

# Iterate the DataFrame
for week, df in data_frames.items():
    # Select columns of type float64 and int64
```

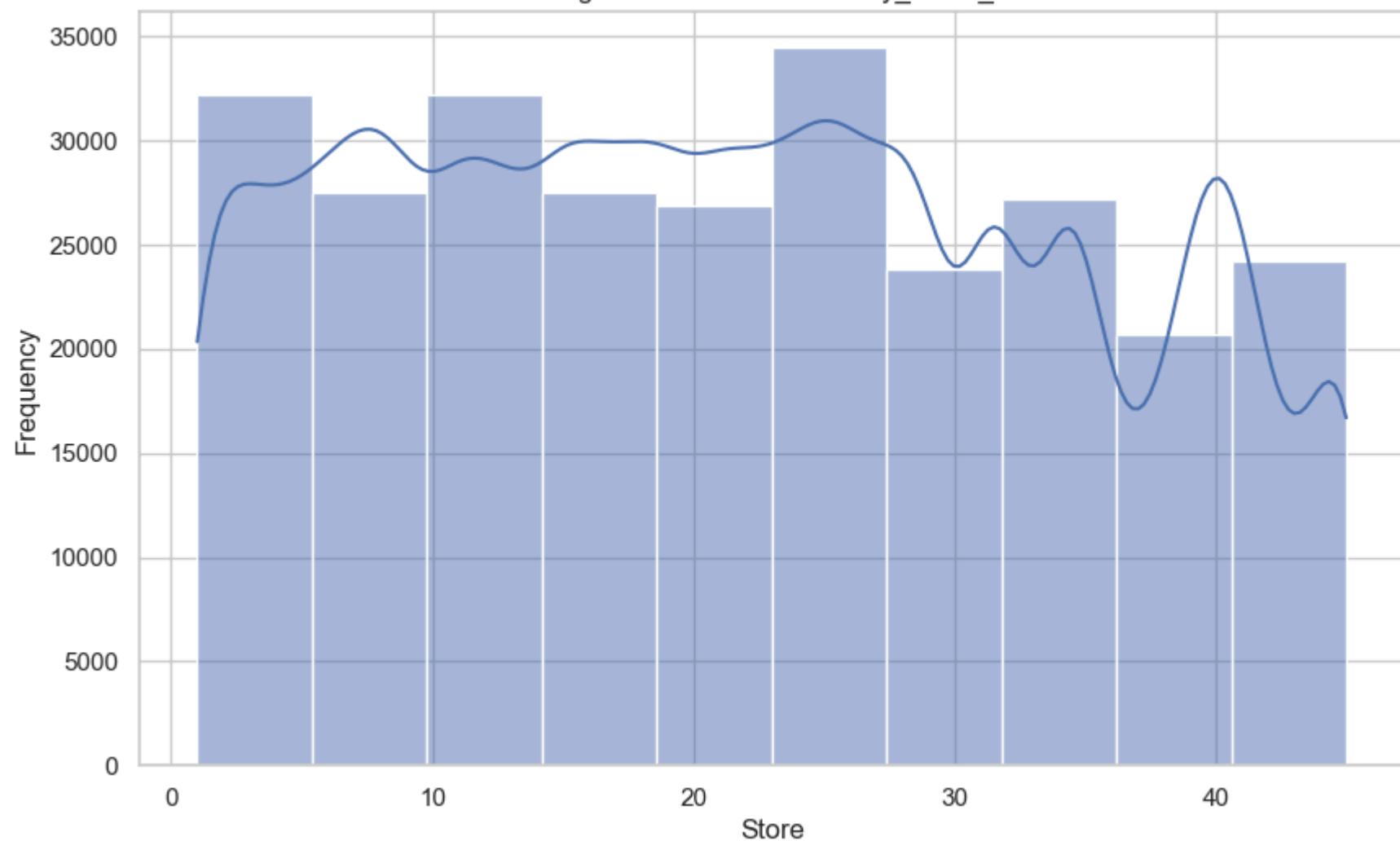
```
numerical_df = df.select_dtypes(include=['float64', 'int64'])

for column in numerical_df.columns:
    # Draw histograms
    plt.figure(figsize=(10, 6))
    sns.histplot(numerical_df[column], bins=10, kde=True)
    plt.title(f'Histogram of {column} with {week}')
    plt.xlabel(f'{column}')
    plt.ylabel('Frequency')
    plt.show()
    plt.close()

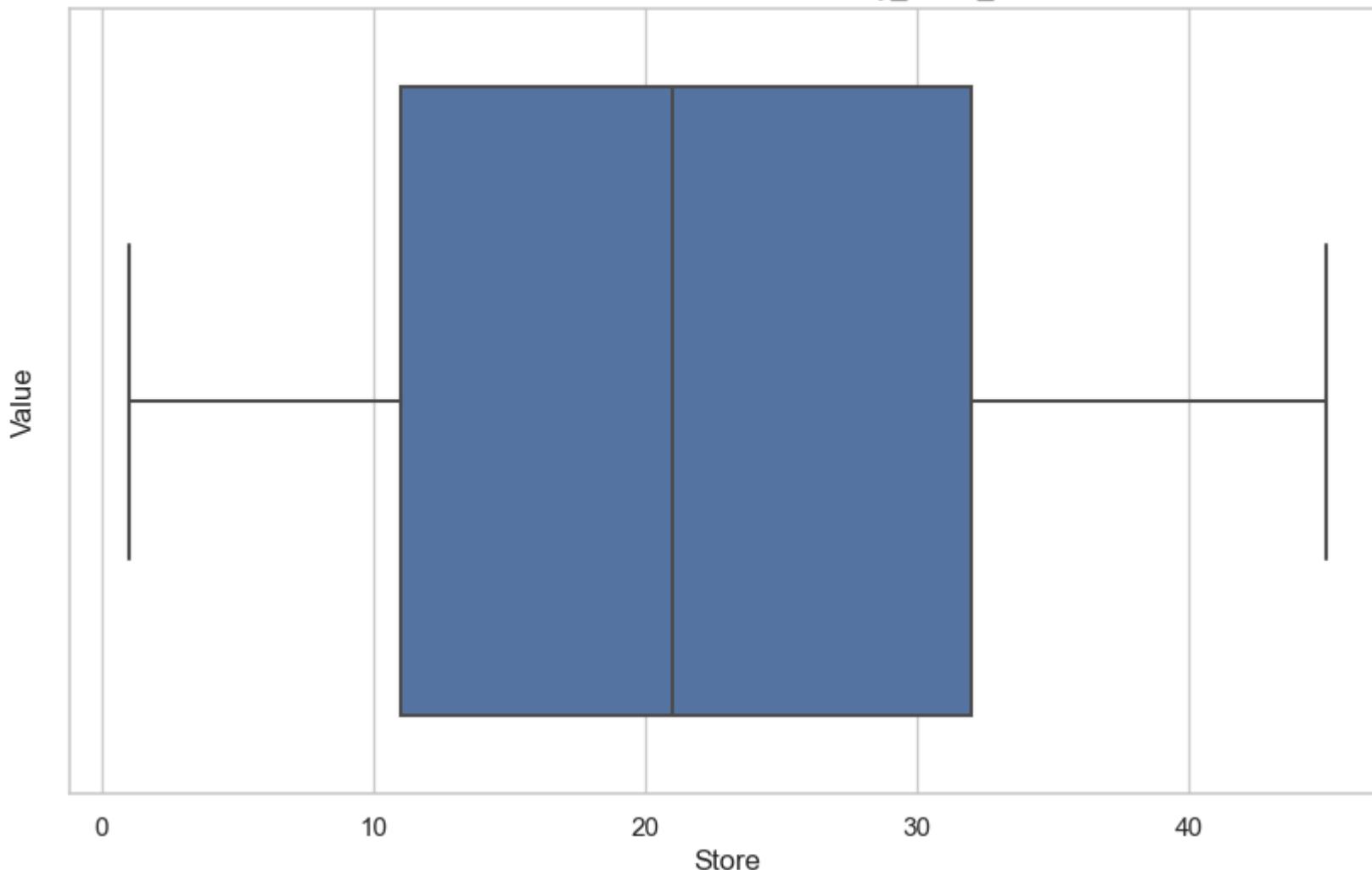
    # Draw box diagrams
    plt.figure(figsize=(10, 6))
    sns.boxplot(x=numerical_df[column])
    plt.title(f'Box Plot of {column} in Data with {week}')
    plt.xlabel(column)
    plt.ylabel('Value')
    plt.show()
    plt.close()
```

/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.
with pd.option_context('mode.use_inf_as_na', True):

Histogram of Store with Weekly_Sales_2w

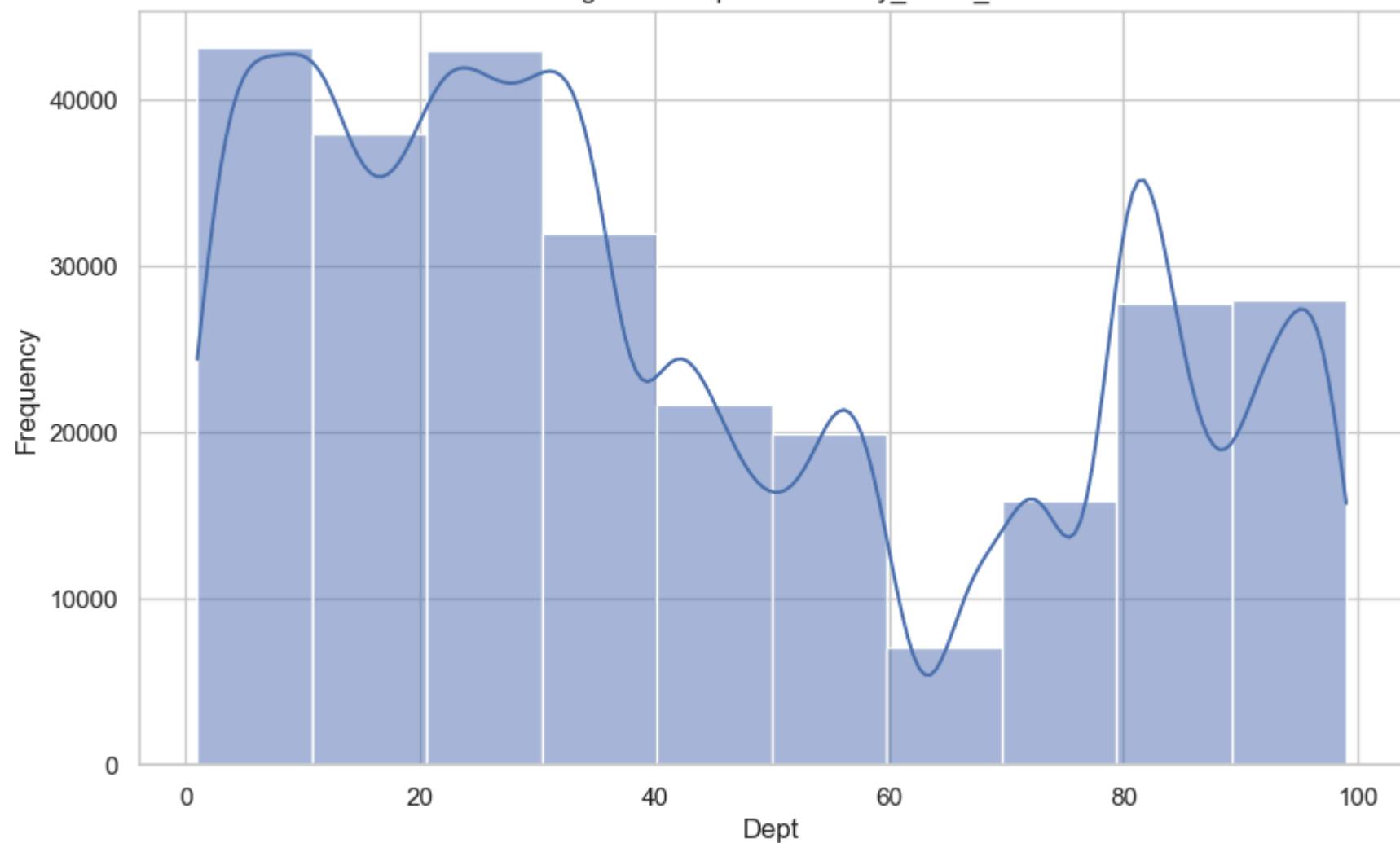


Box Plot of Store in Data with Weekly_Sales_2w

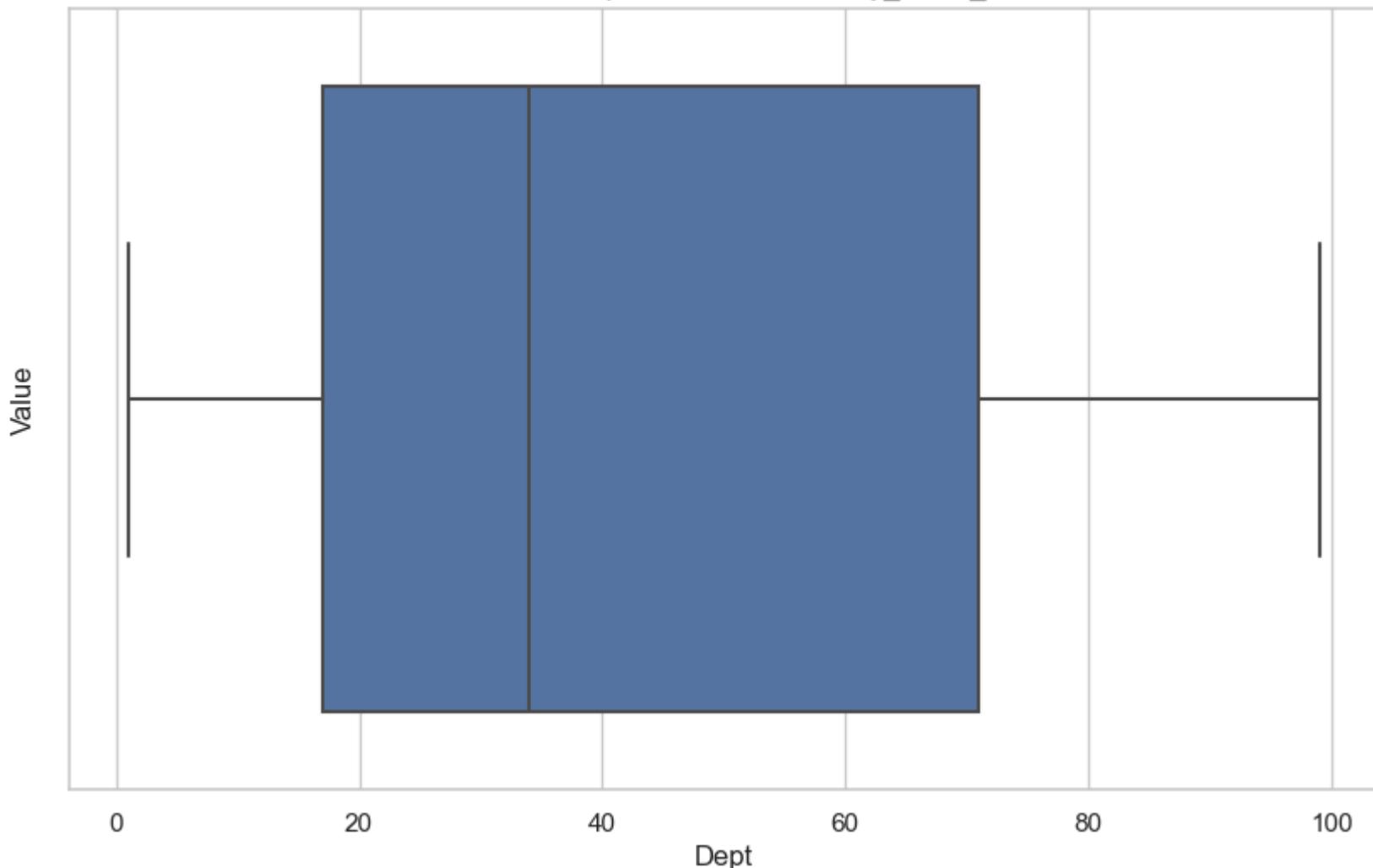


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_2w

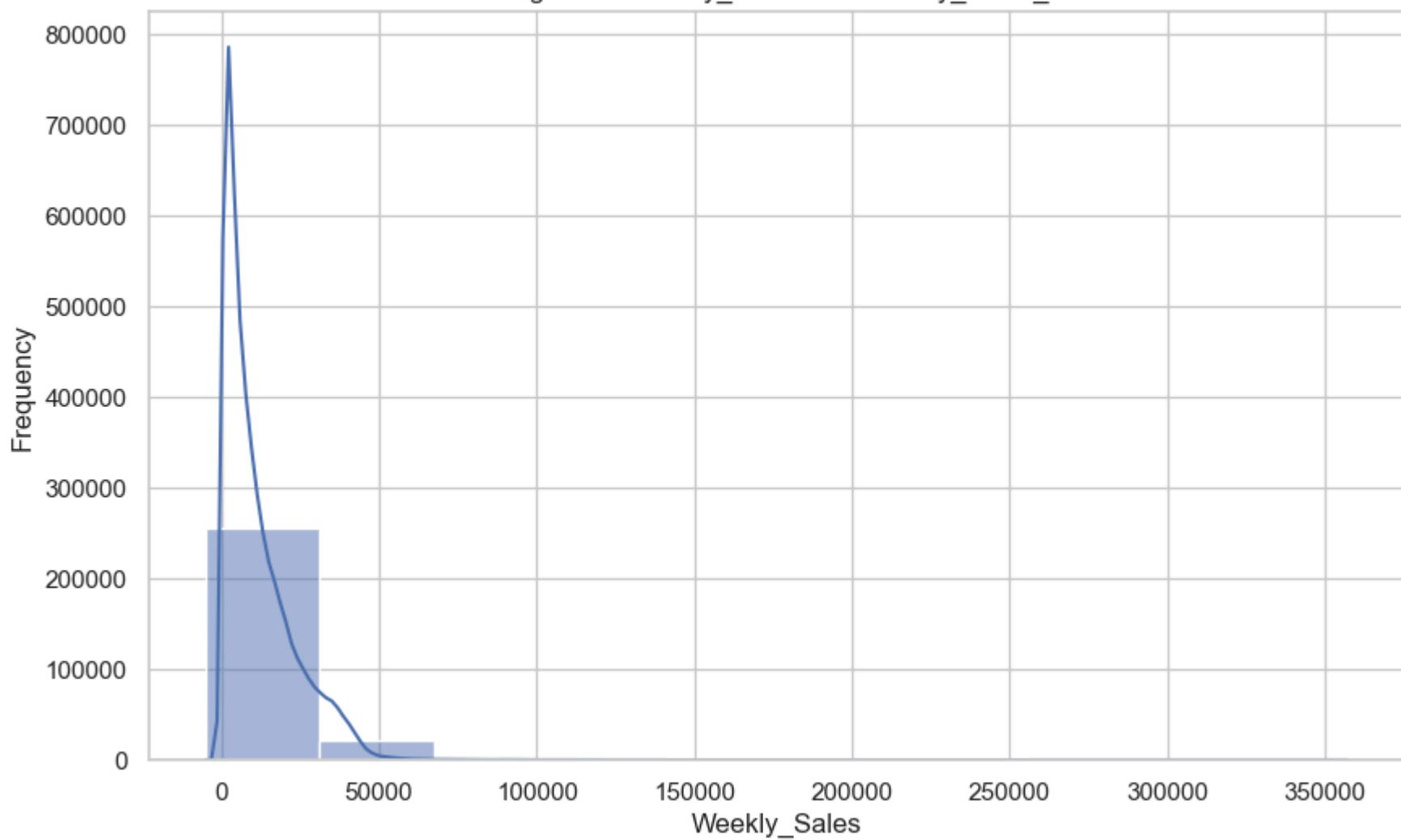


Box Plot of Dept in Data with Weekly_Sales_2w

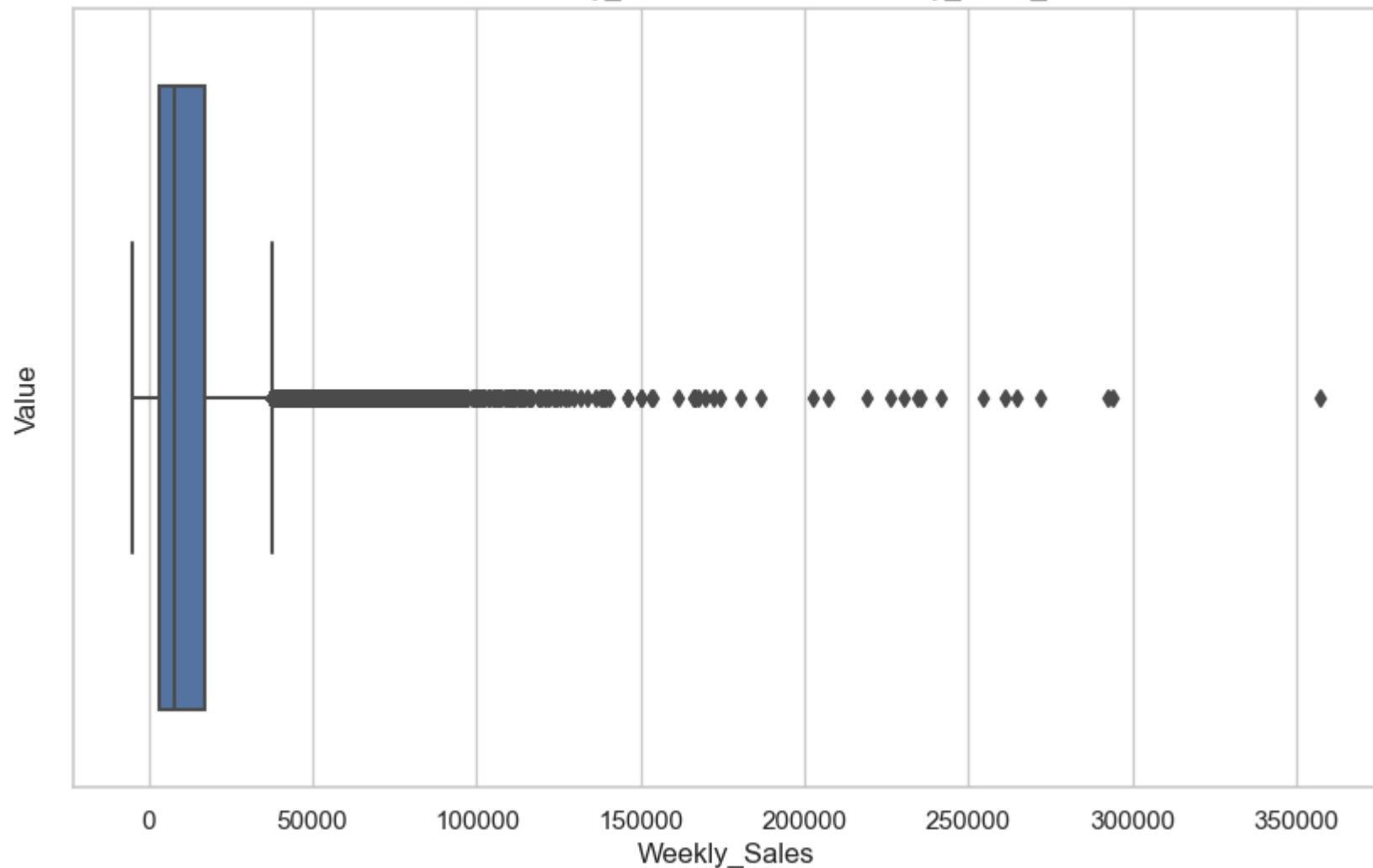


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_2w

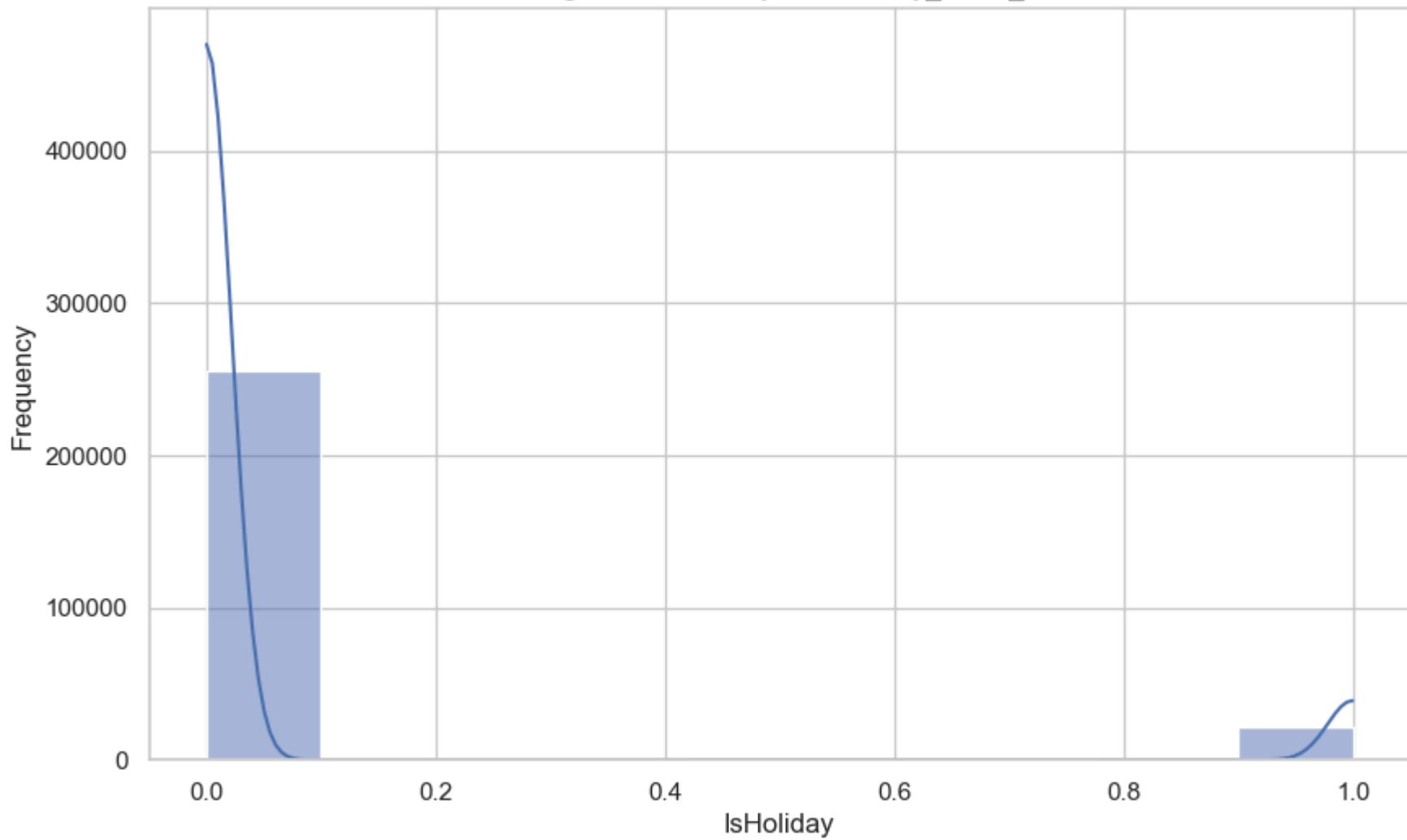


Box Plot of Weekly_Sales in Data with Weekly_Sales_2w

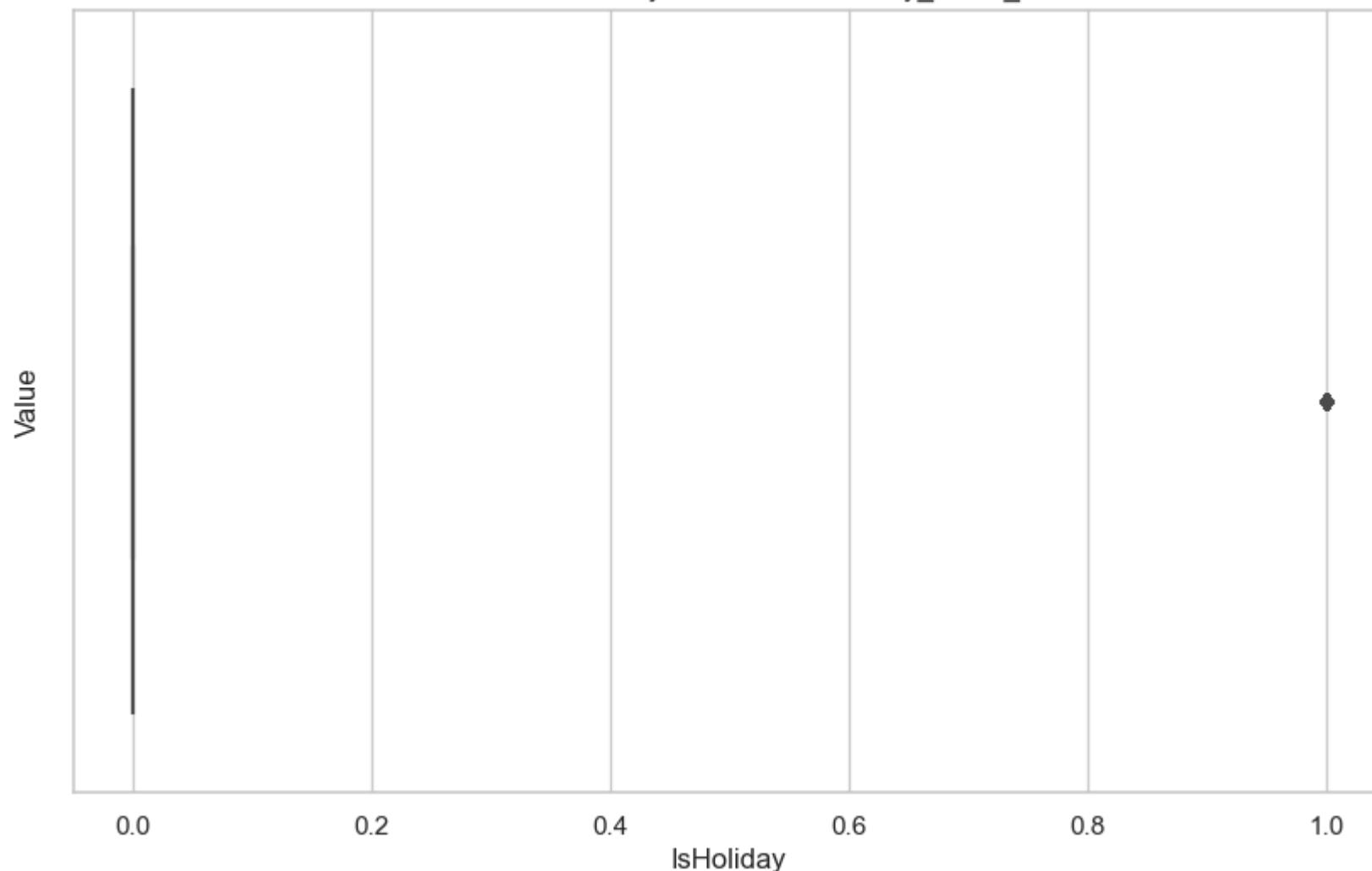


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_2w

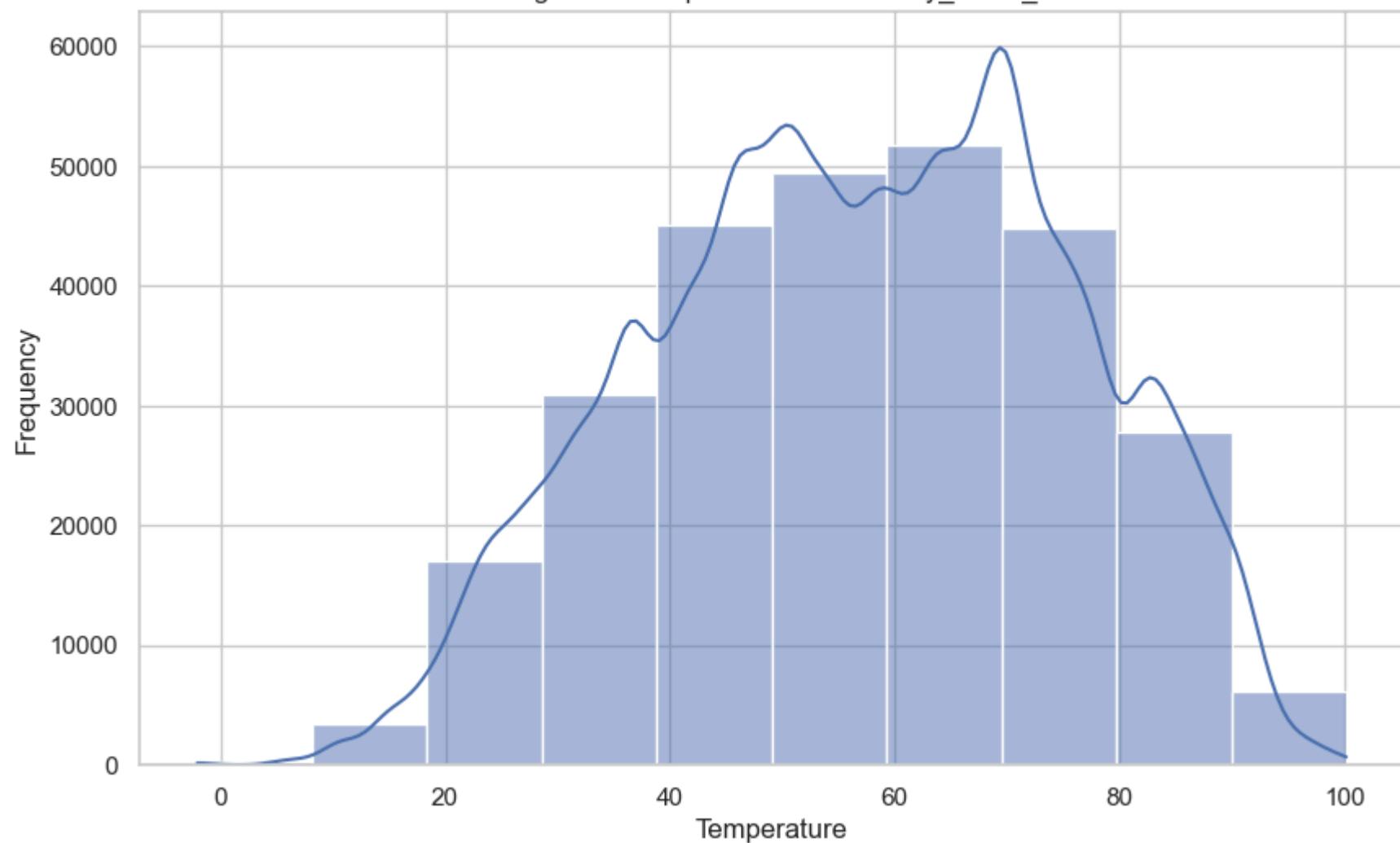


Box Plot of IsHoliday in Data with Weekly_Sales_2w

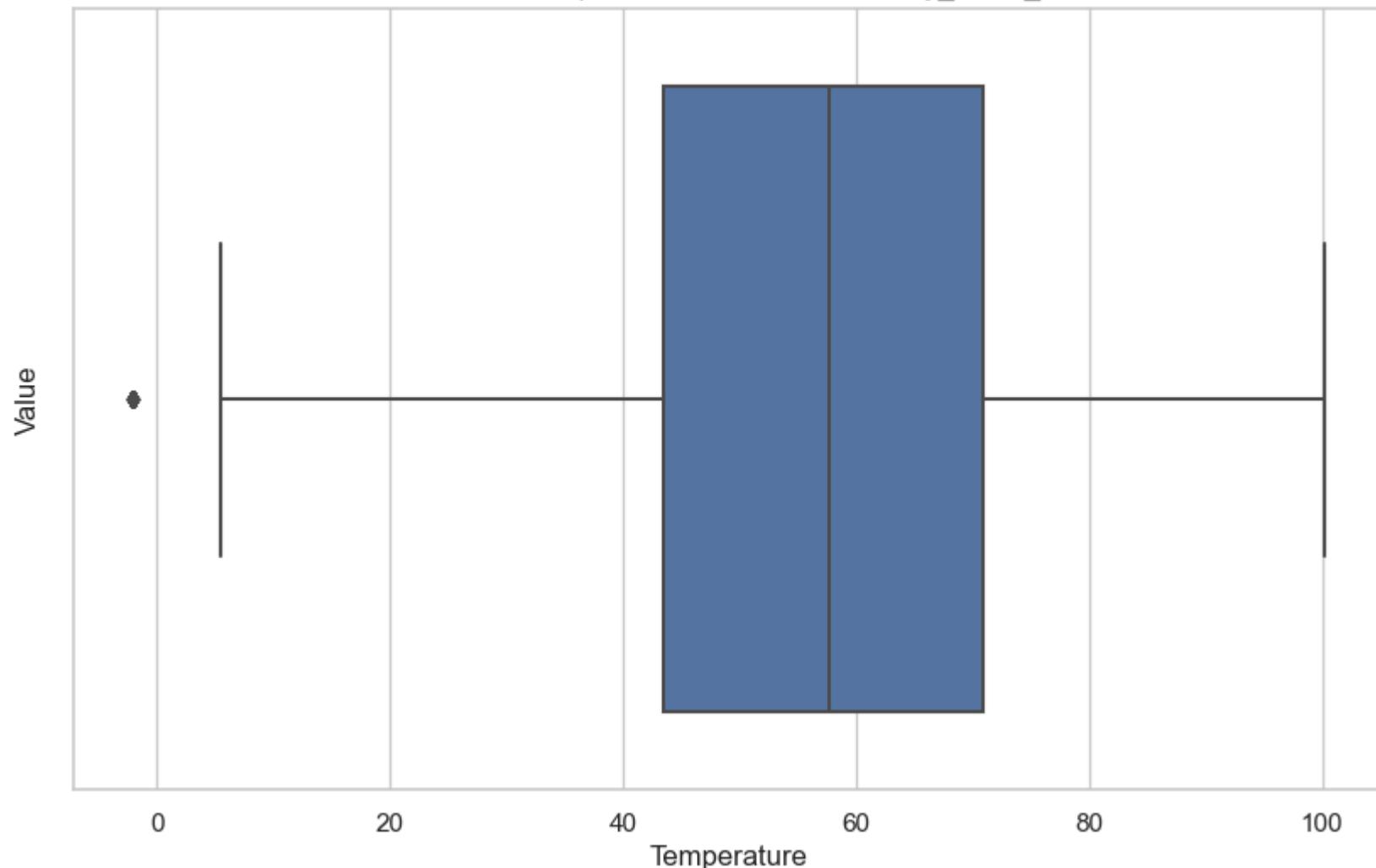


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_2w

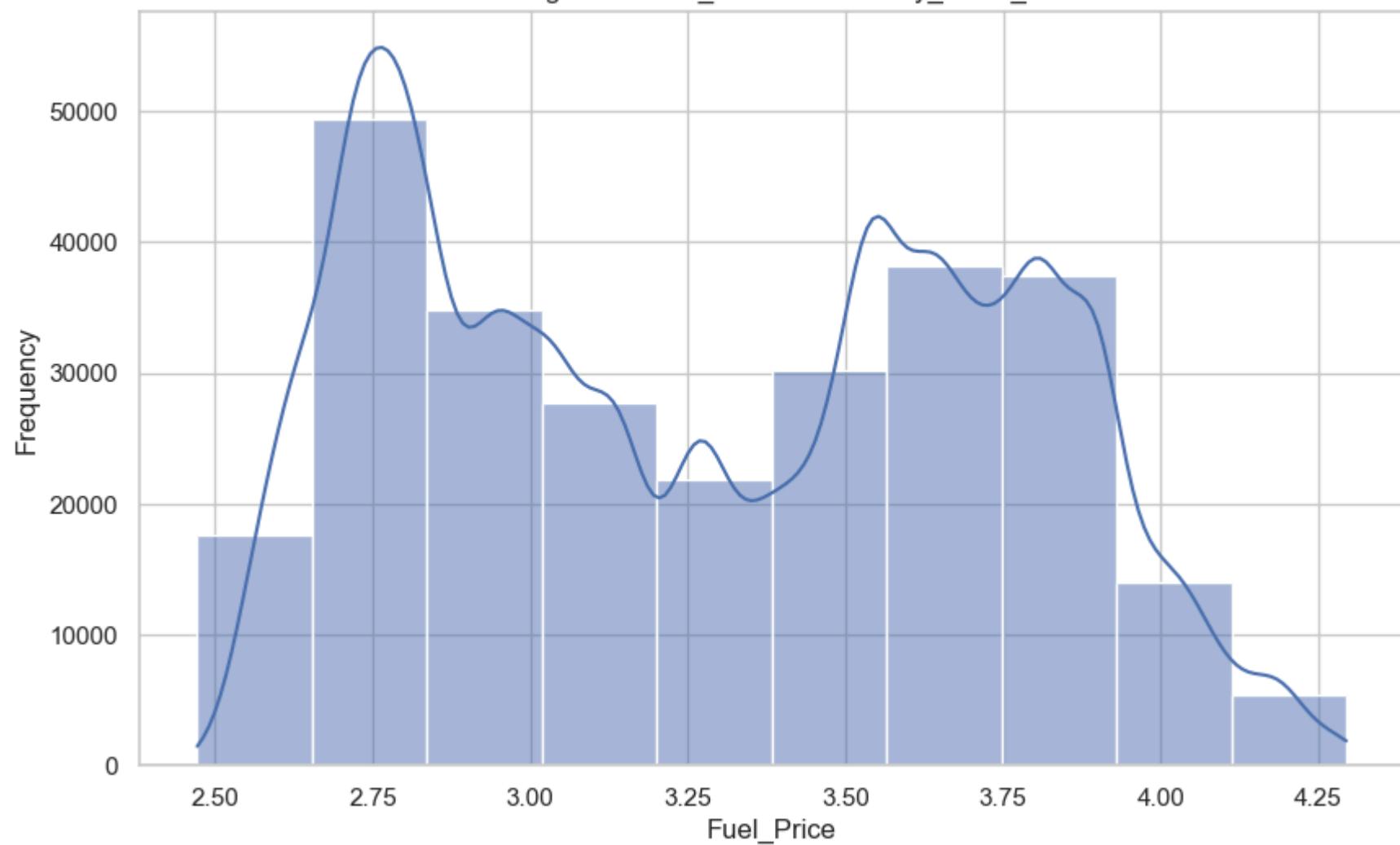


Box Plot of Temperature in Data with Weekly_Sales_2w

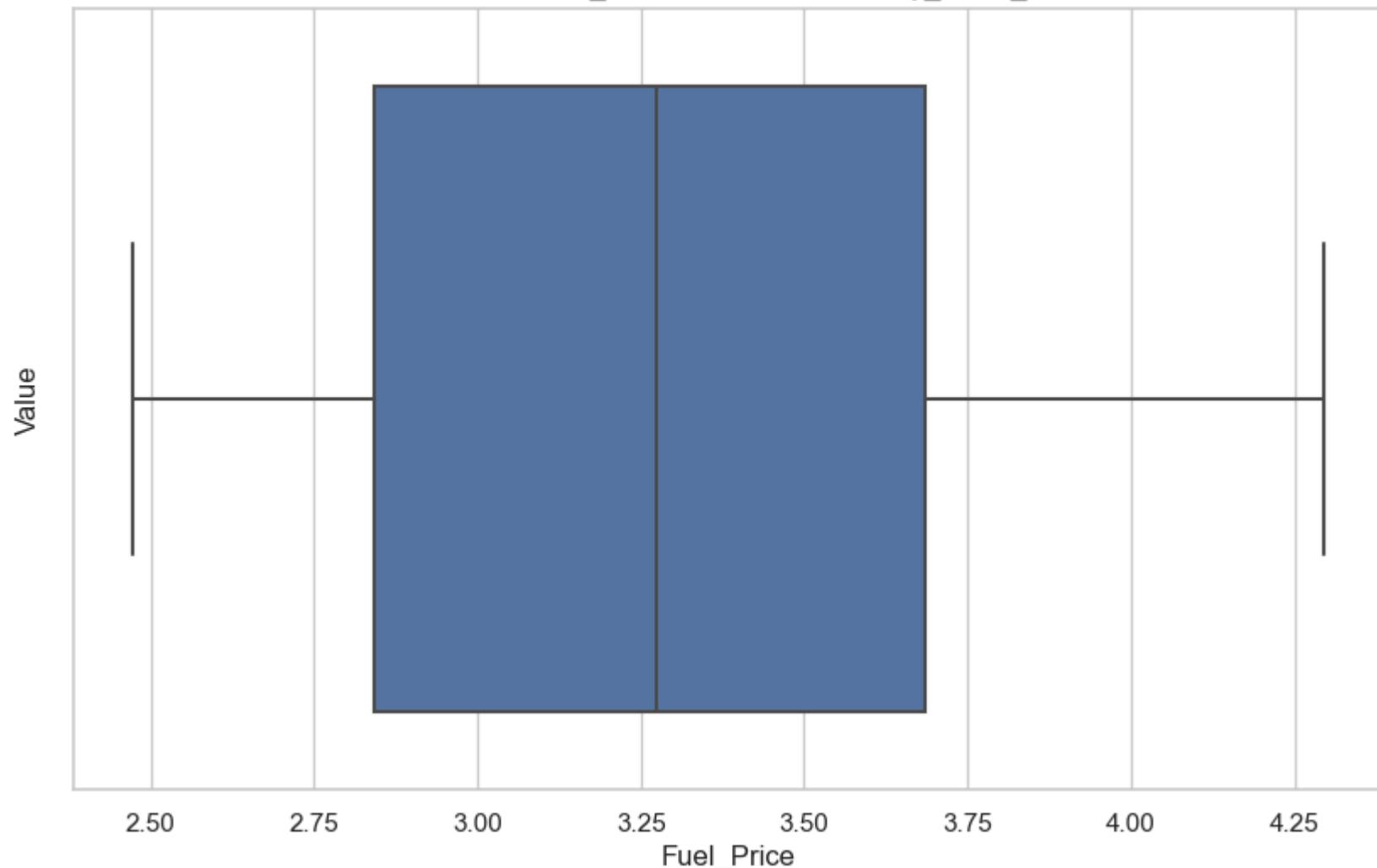


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

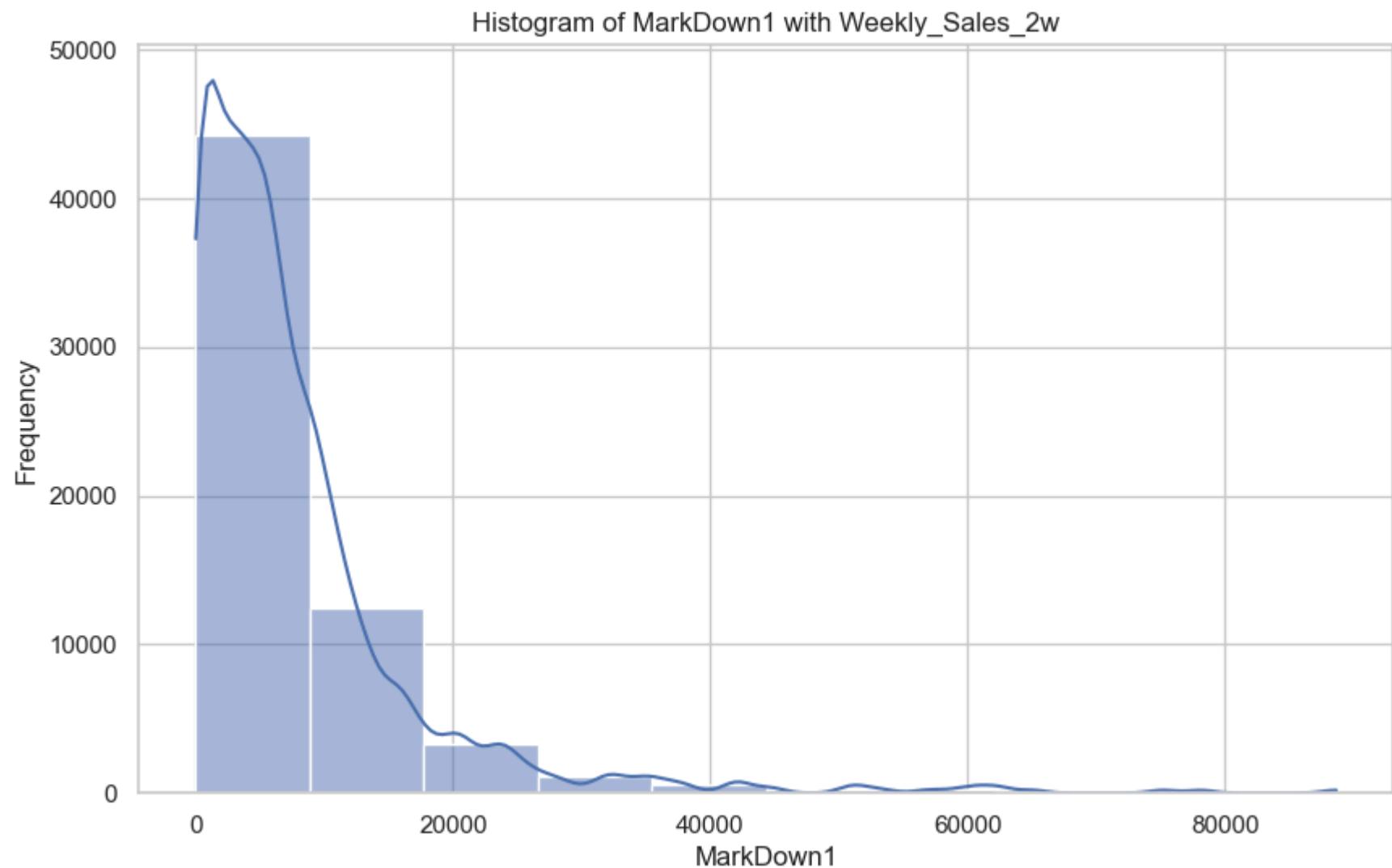
Histogram of Fuel_Price with Weekly_Sales_2w



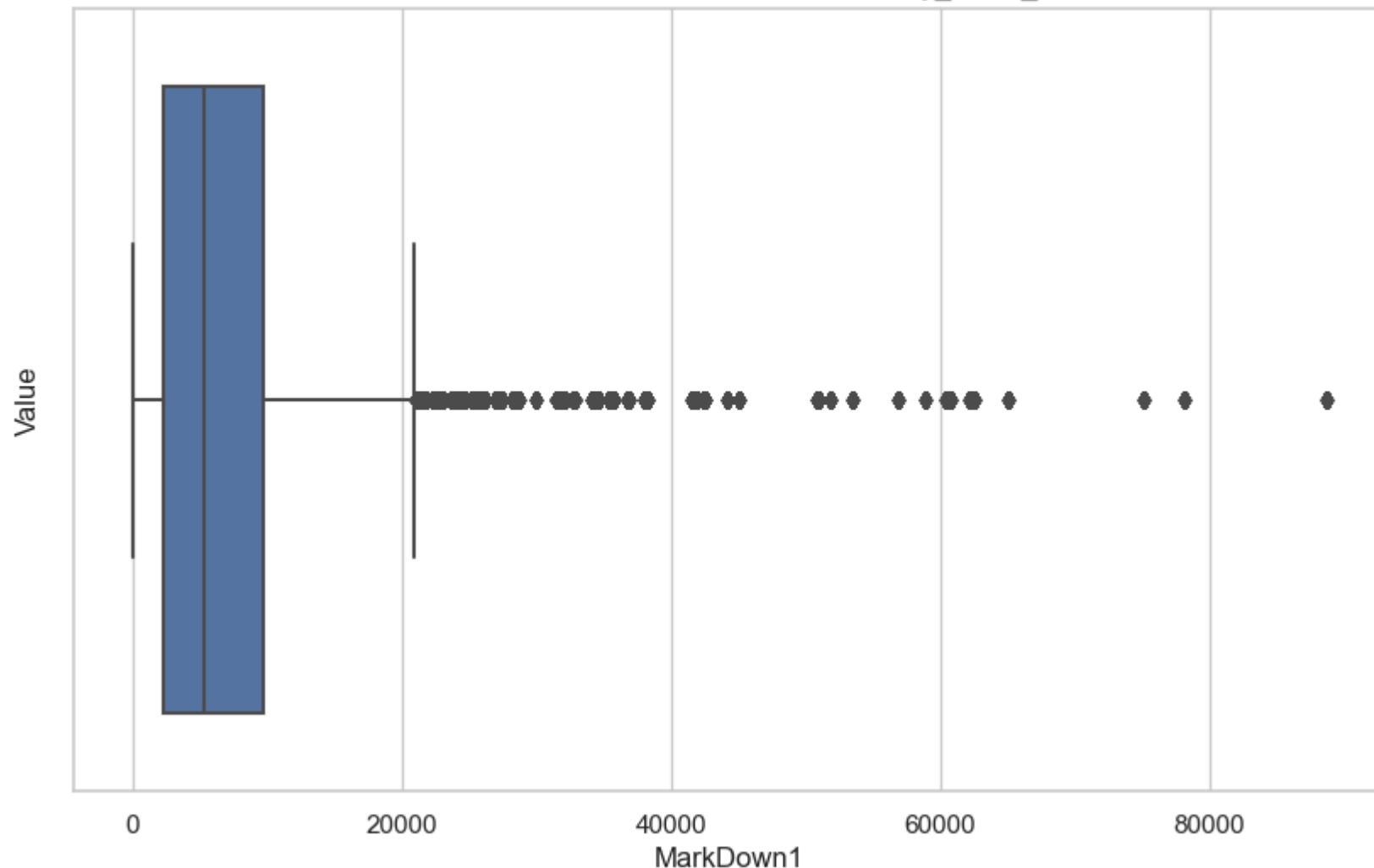
Box Plot of Fuel_Price in Data with Weekly_Sales_2w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

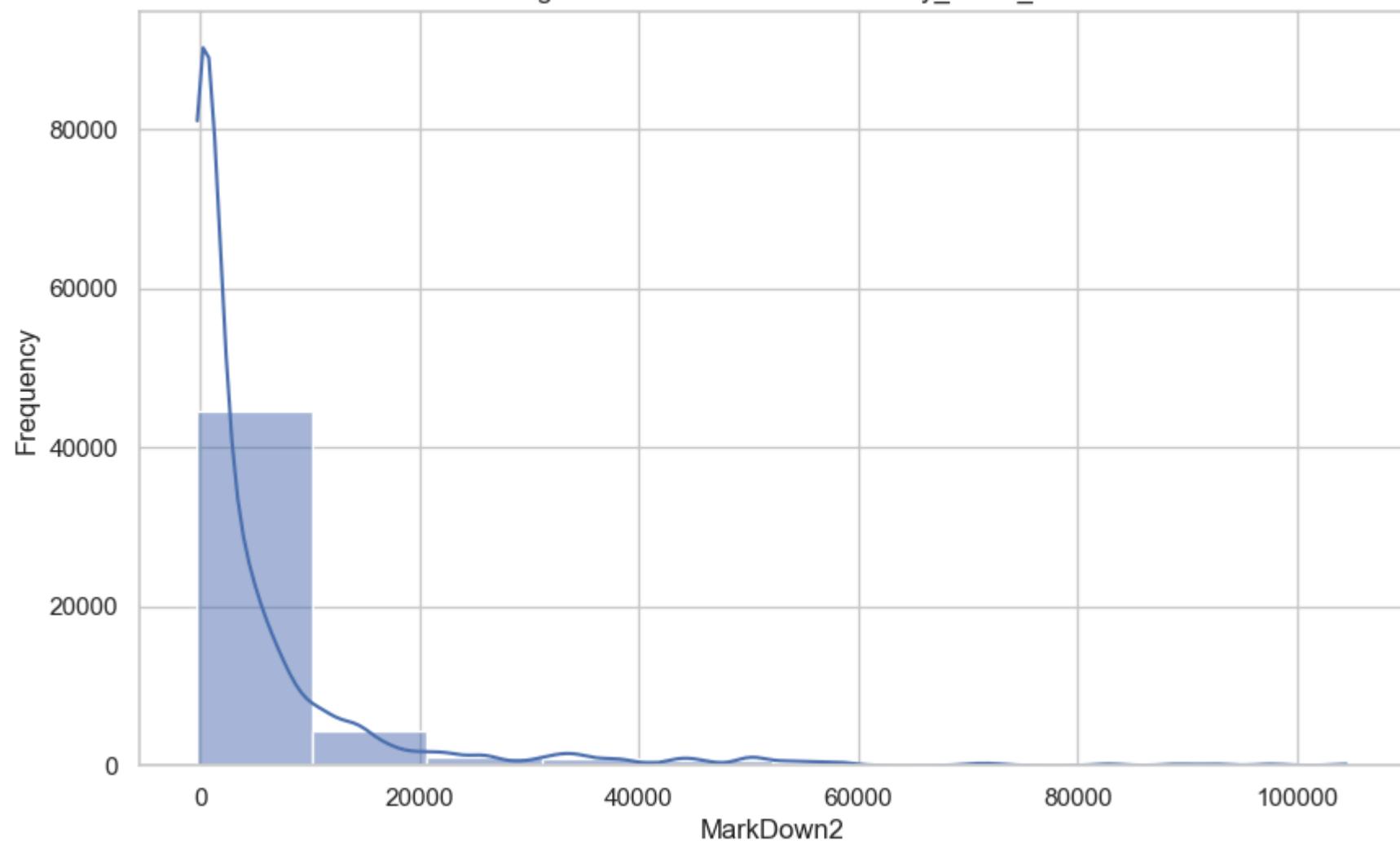


Box Plot of MarkDown1 in Data with Weekly_Sales_2w

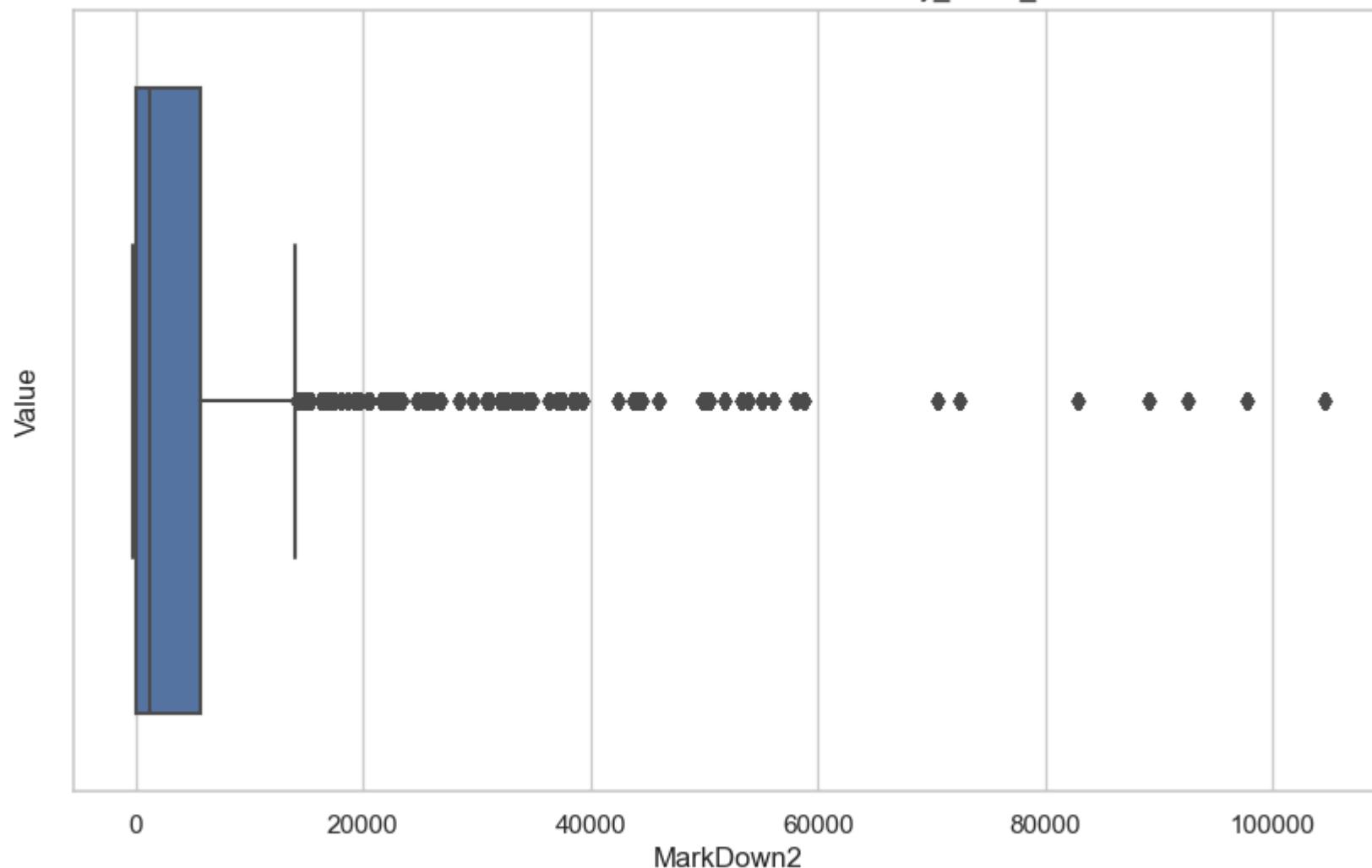


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_2w

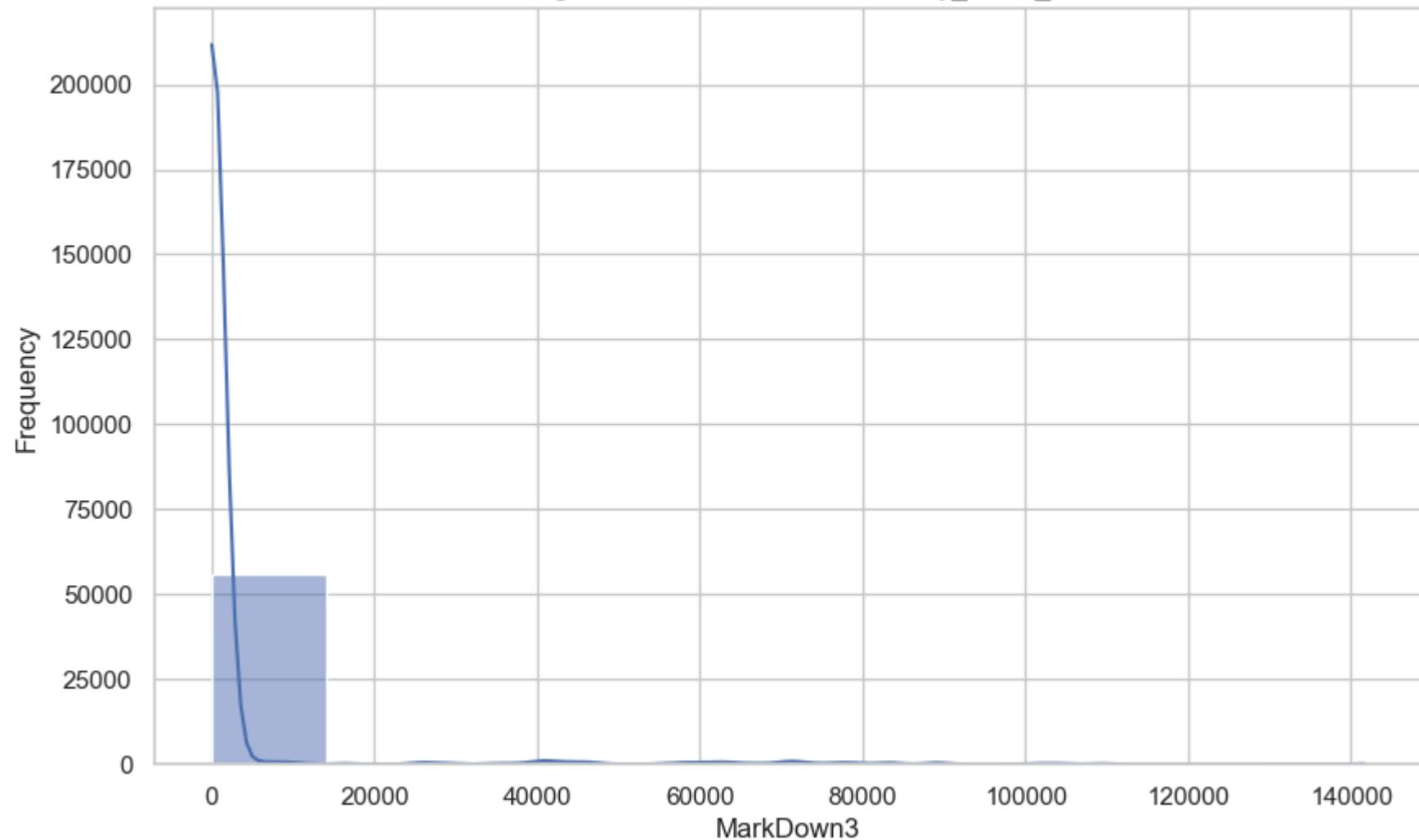


Box Plot of MarkDown2 in Data with Weekly_Sales_2w

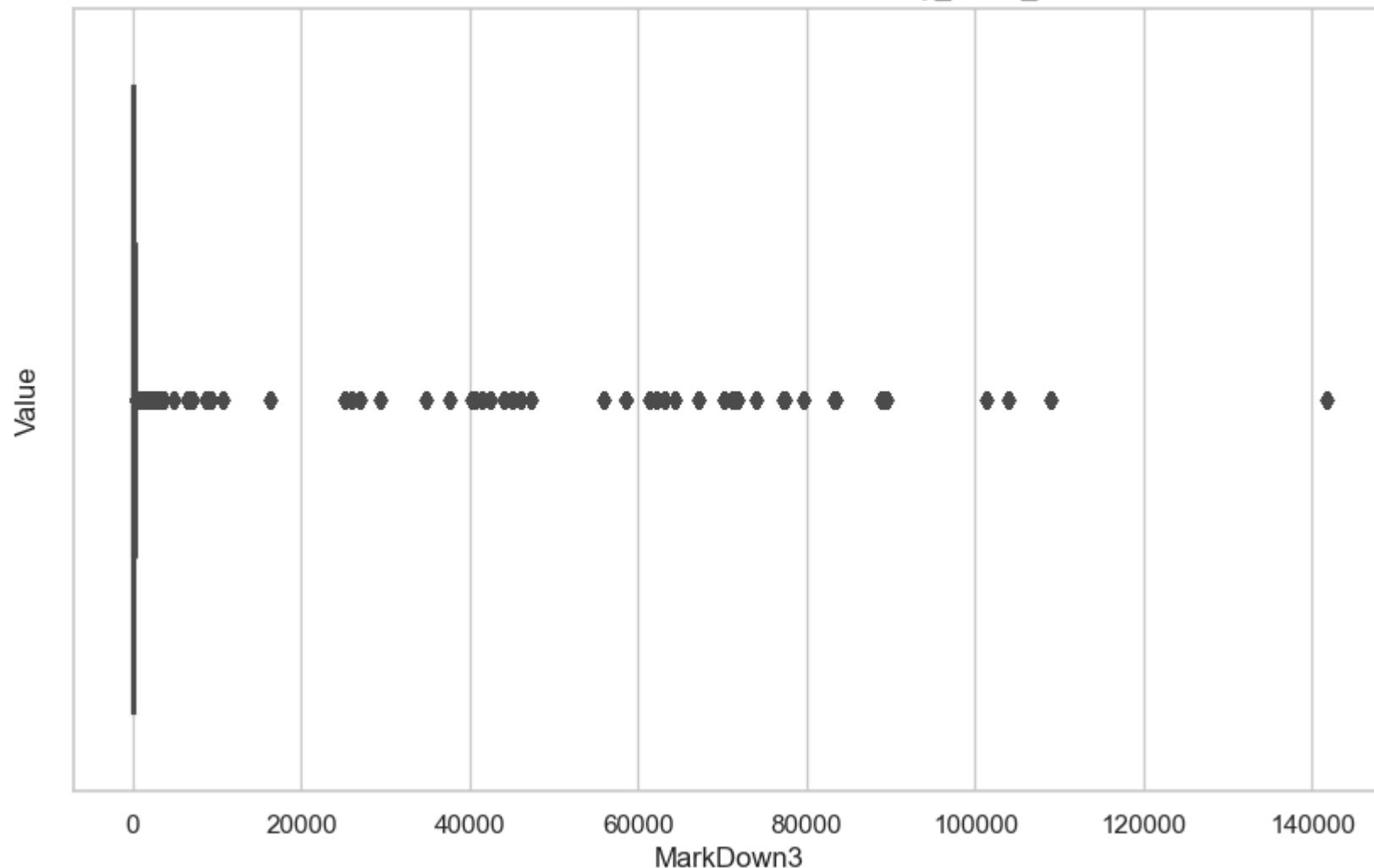


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_2w

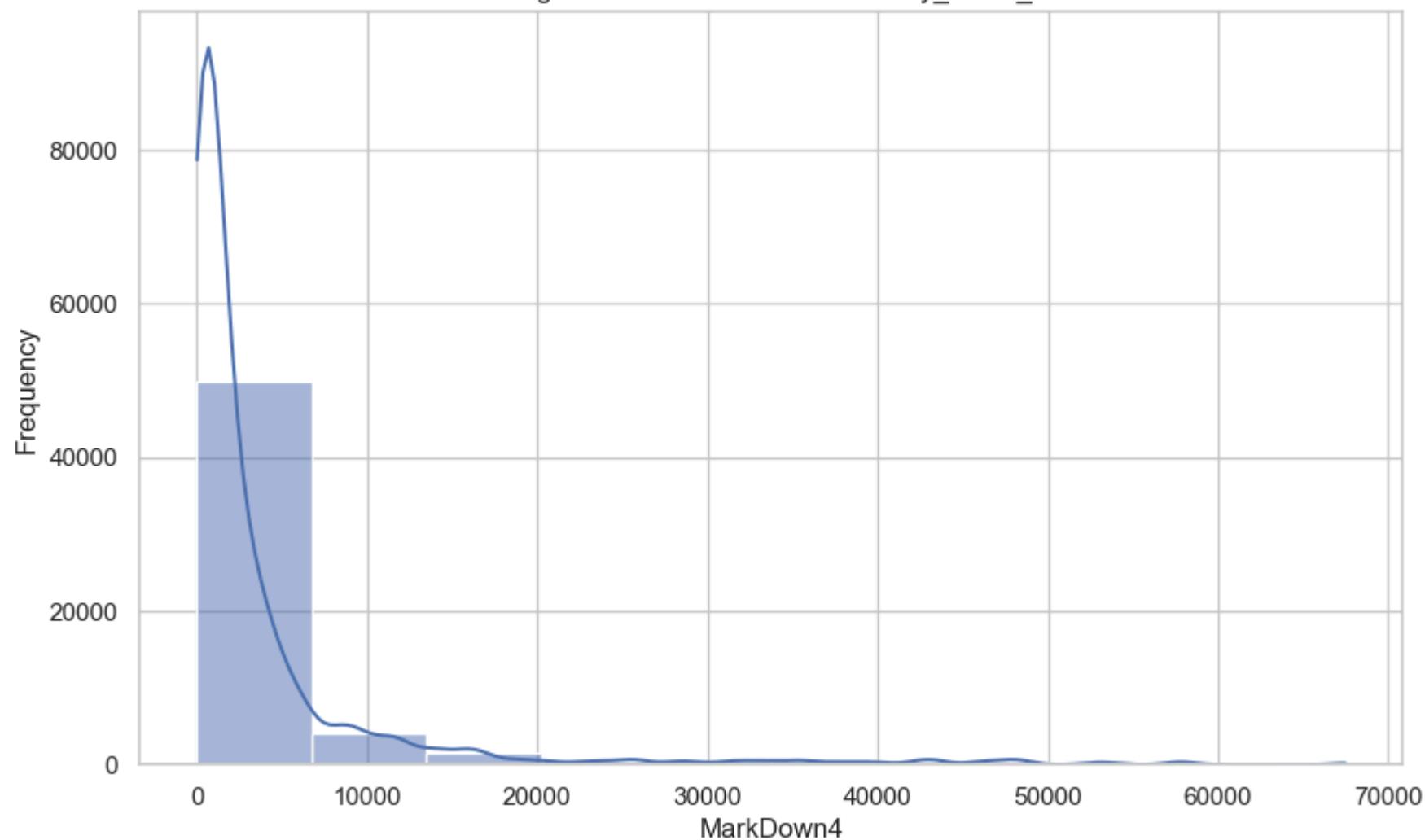


Box Plot of MarkDown3 in Data with Weekly_Sales_2w

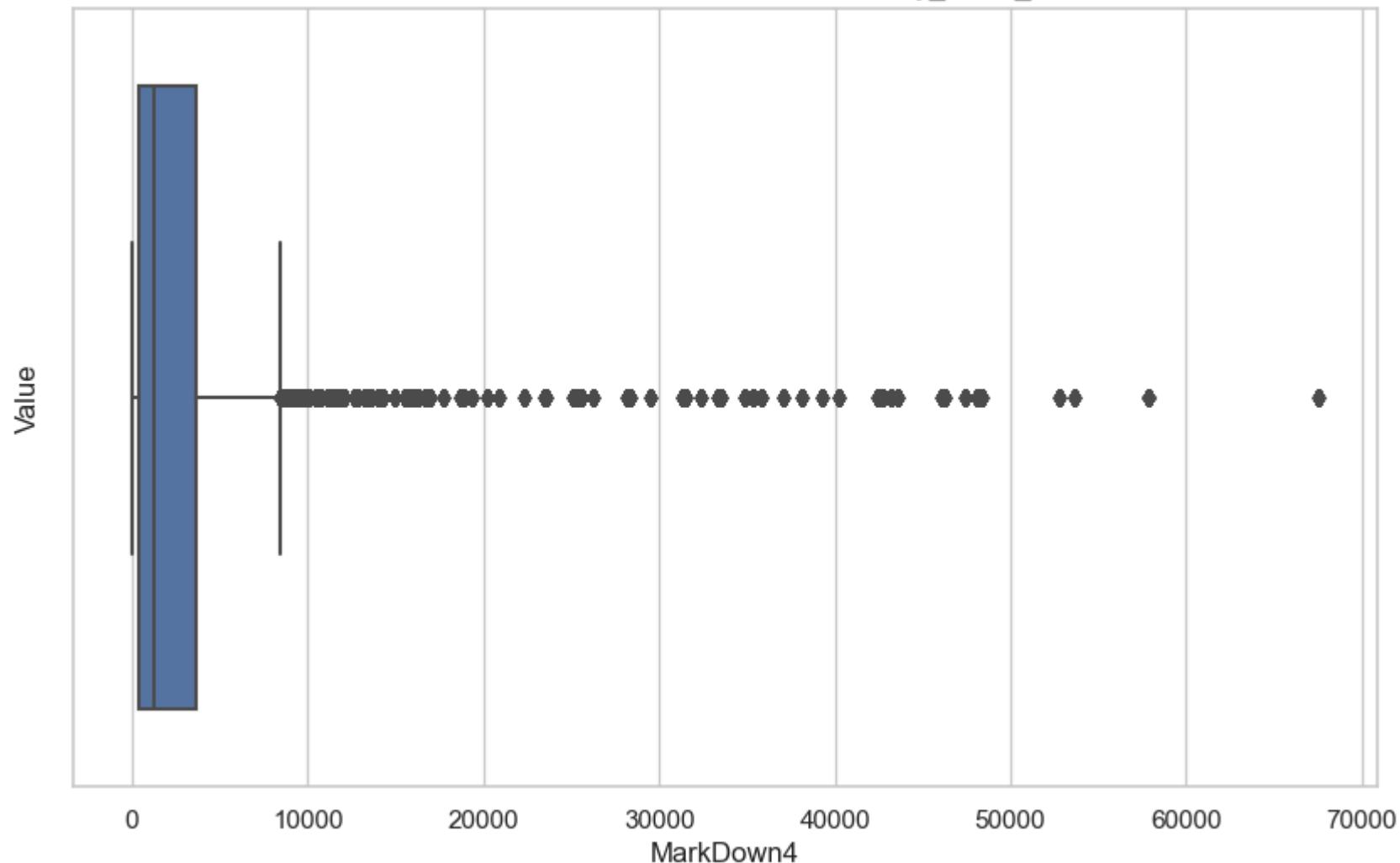


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_2w

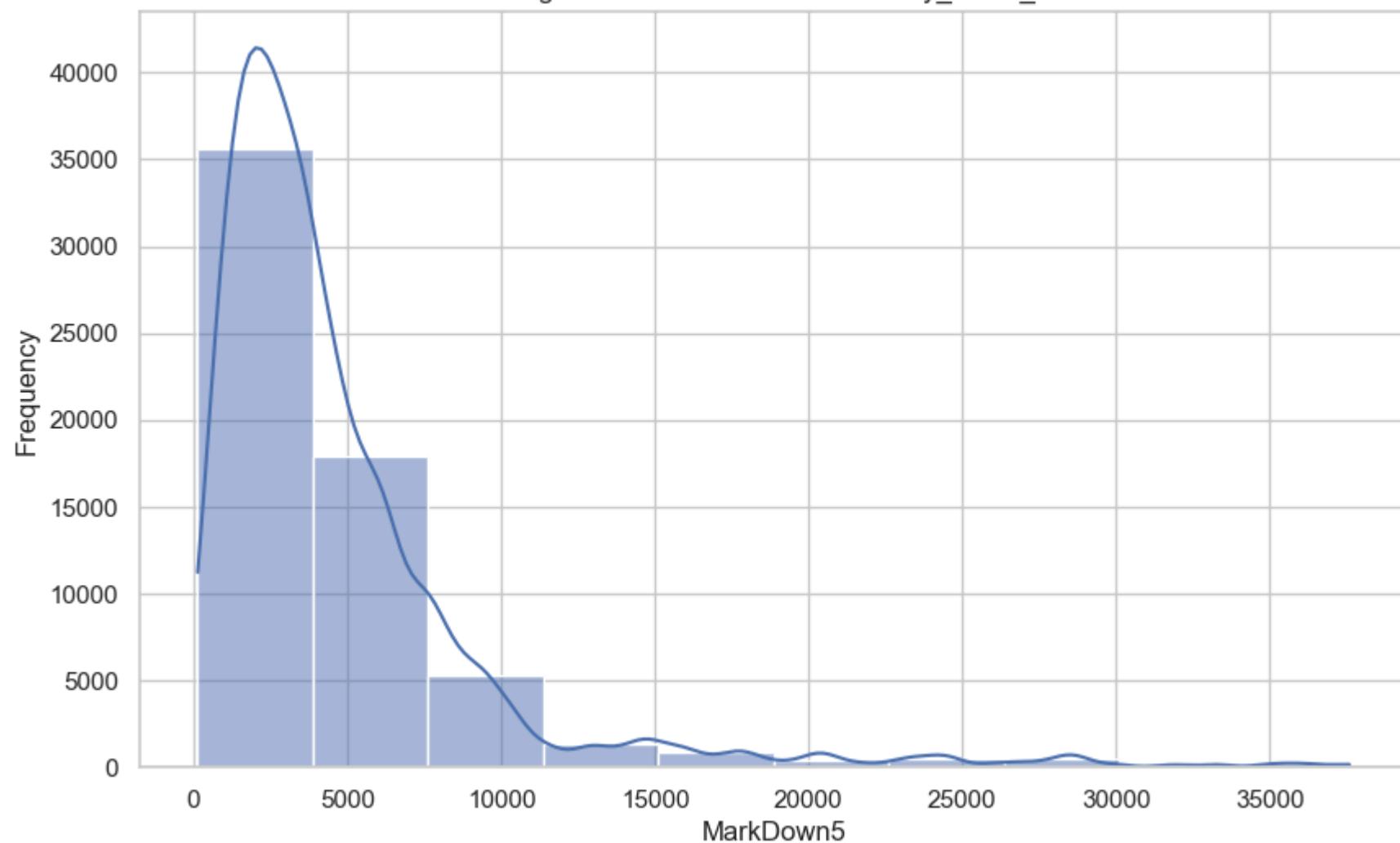


Box Plot of MarkDown4 in Data with Weekly_Sales_2w

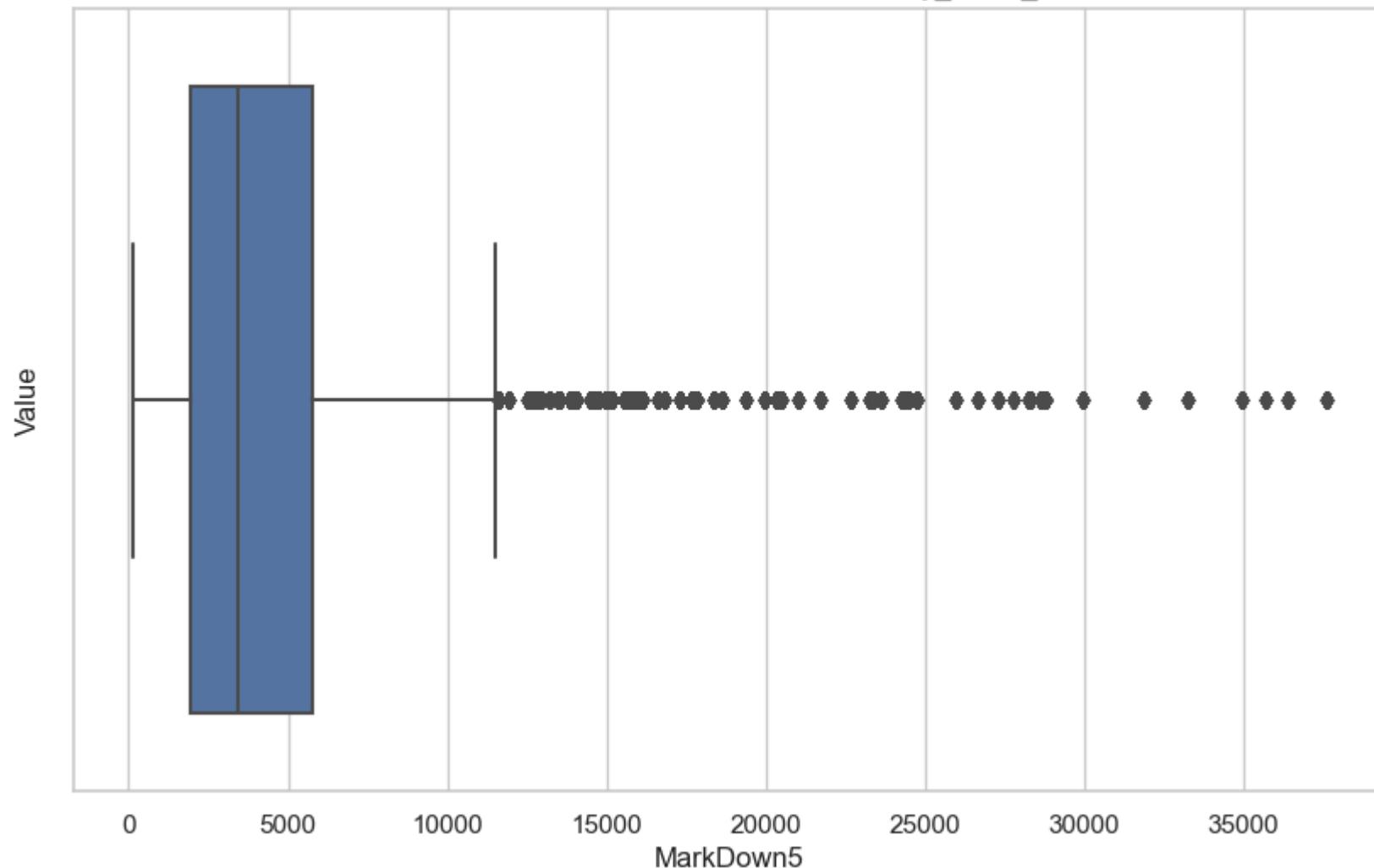


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_2w

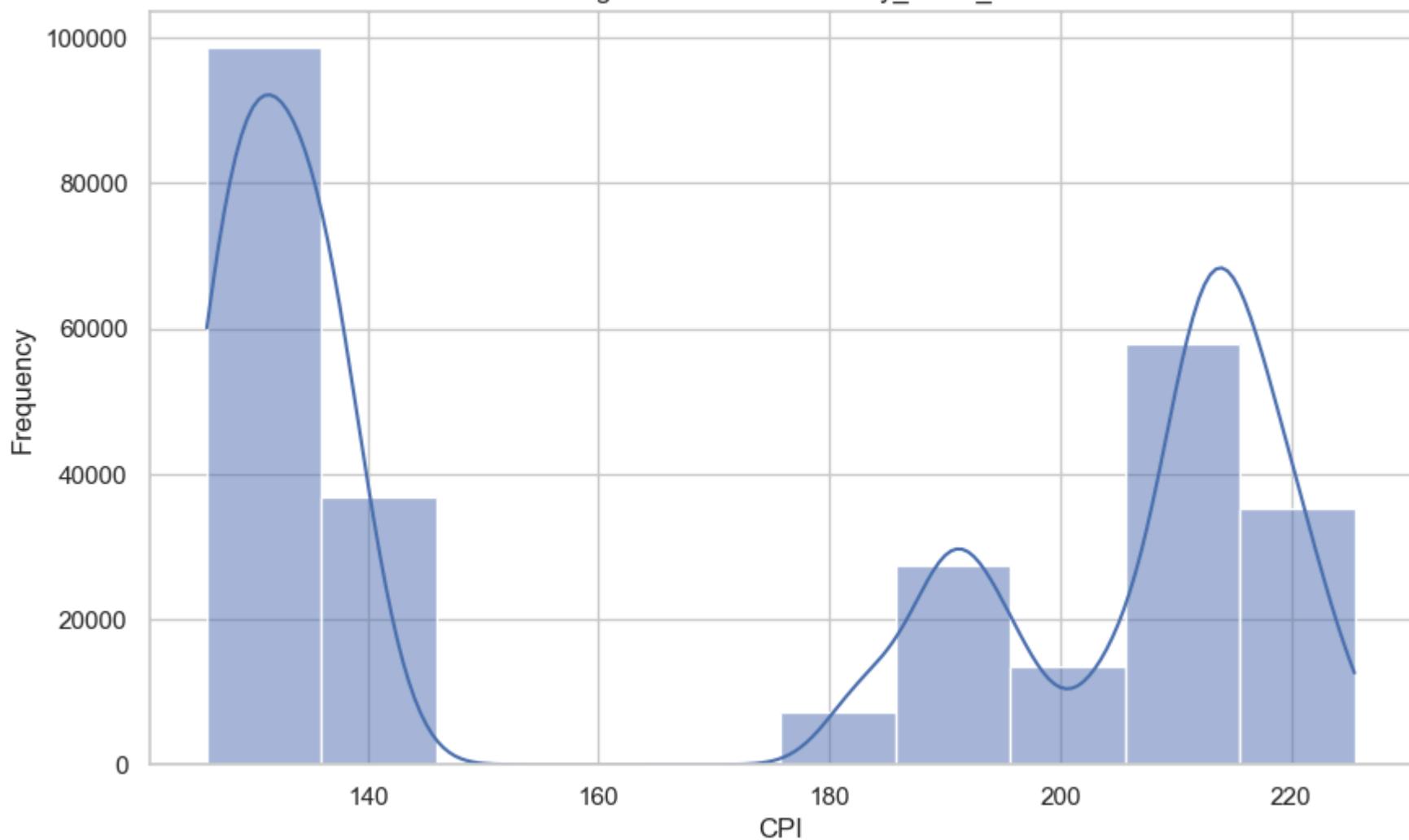


Box Plot of MarkDown5 in Data with Weekly_Sales_2w

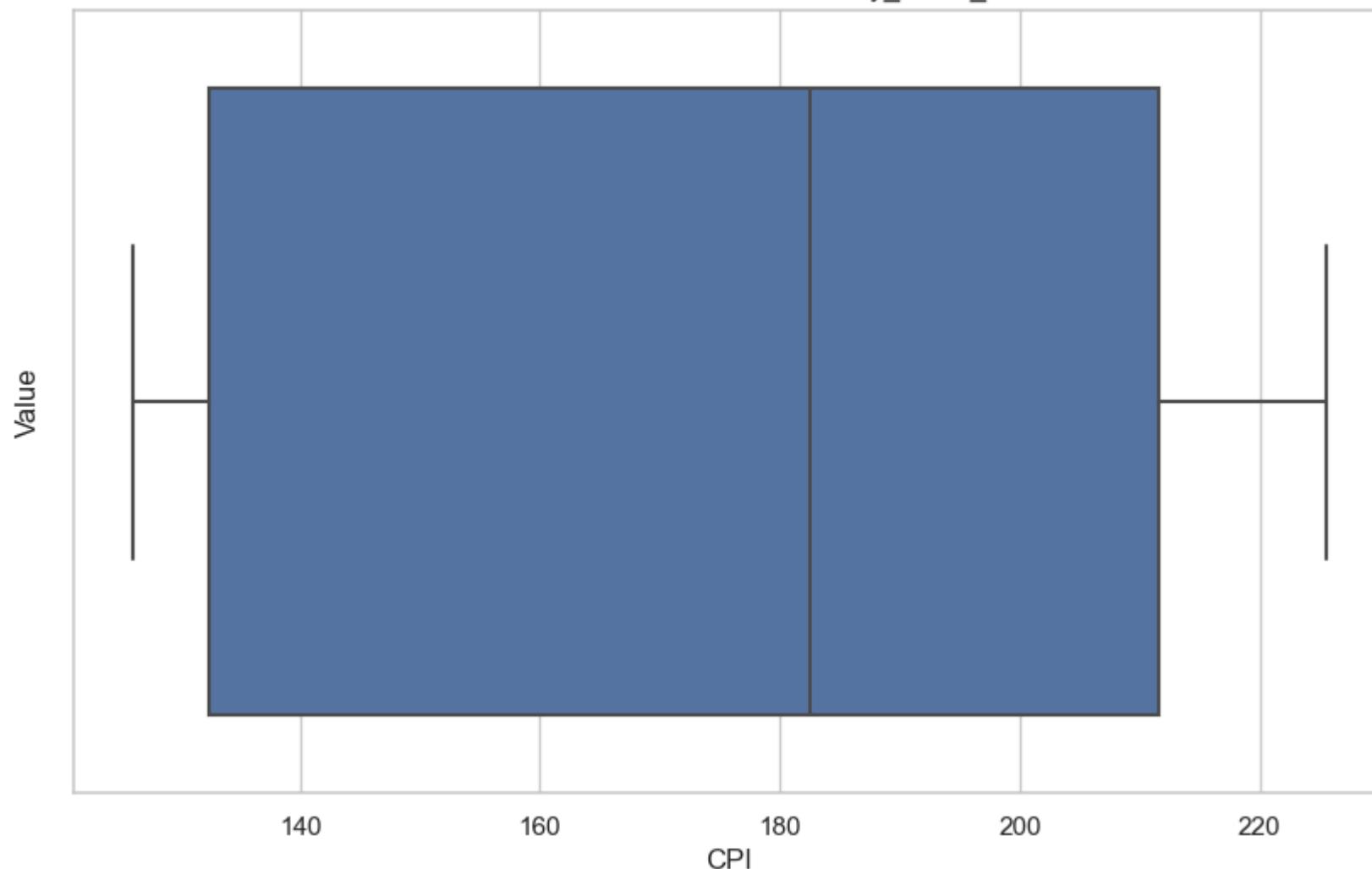


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_2w

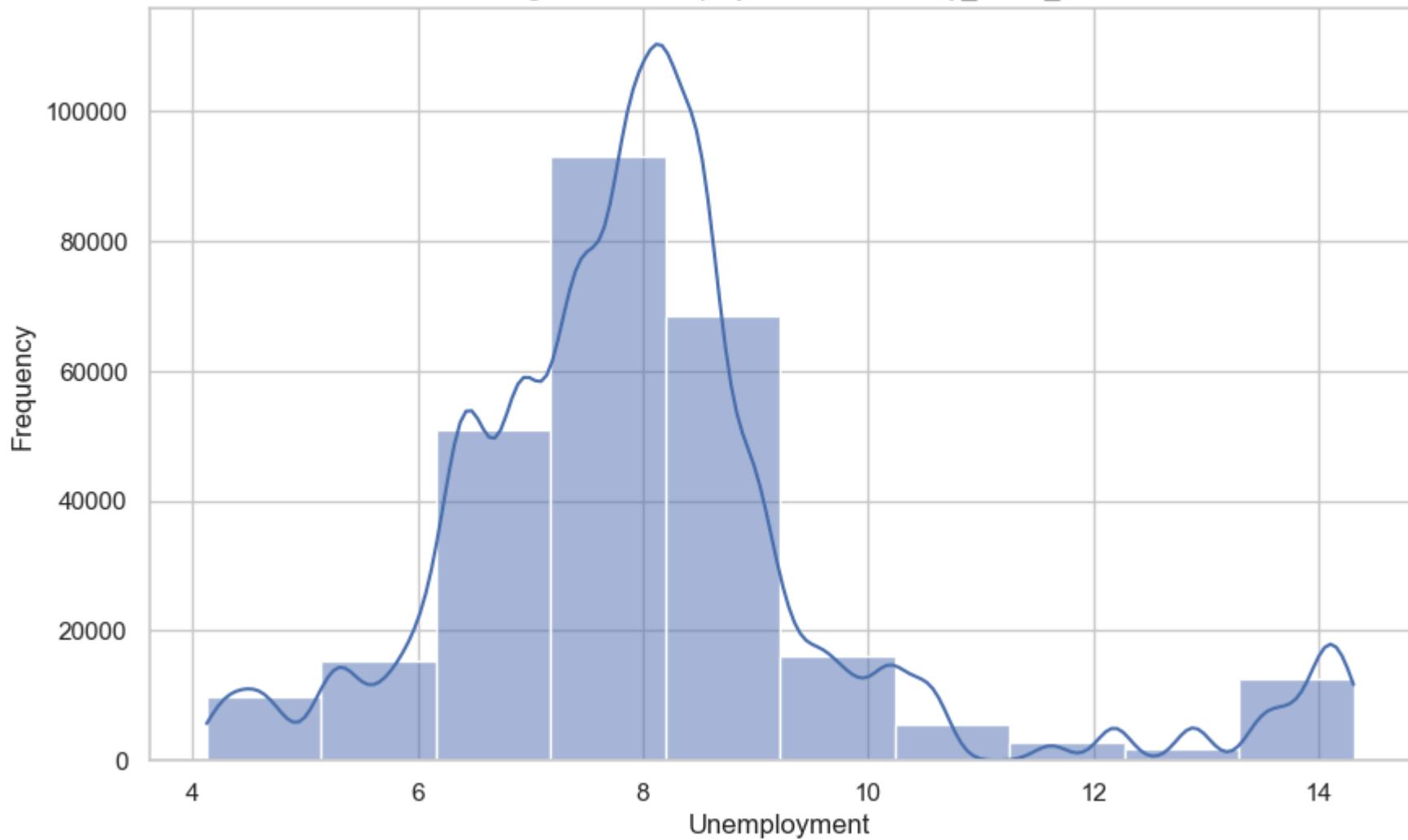


Box Plot of CPI in Data with Weekly_Sales_2w

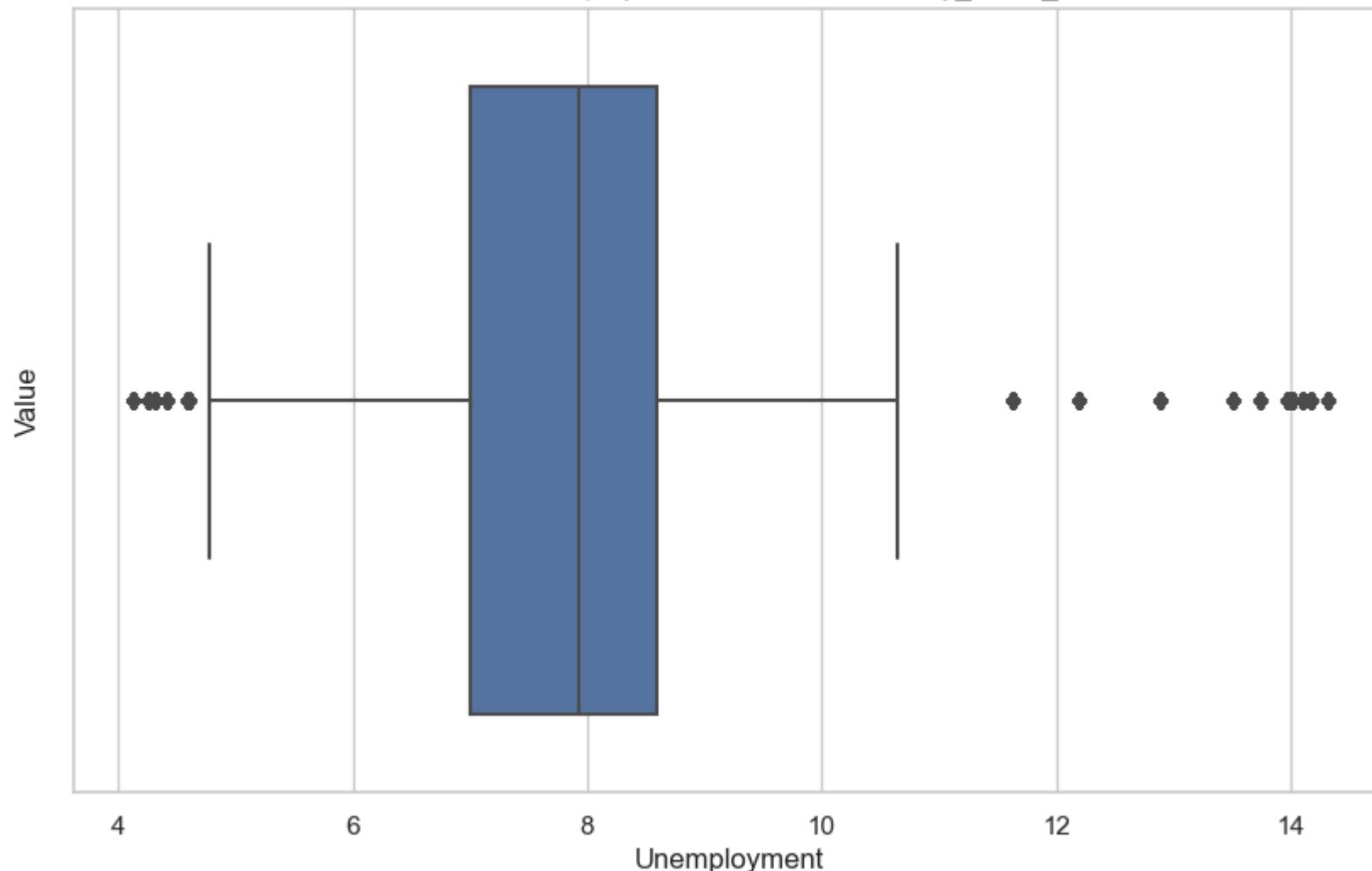


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_2w

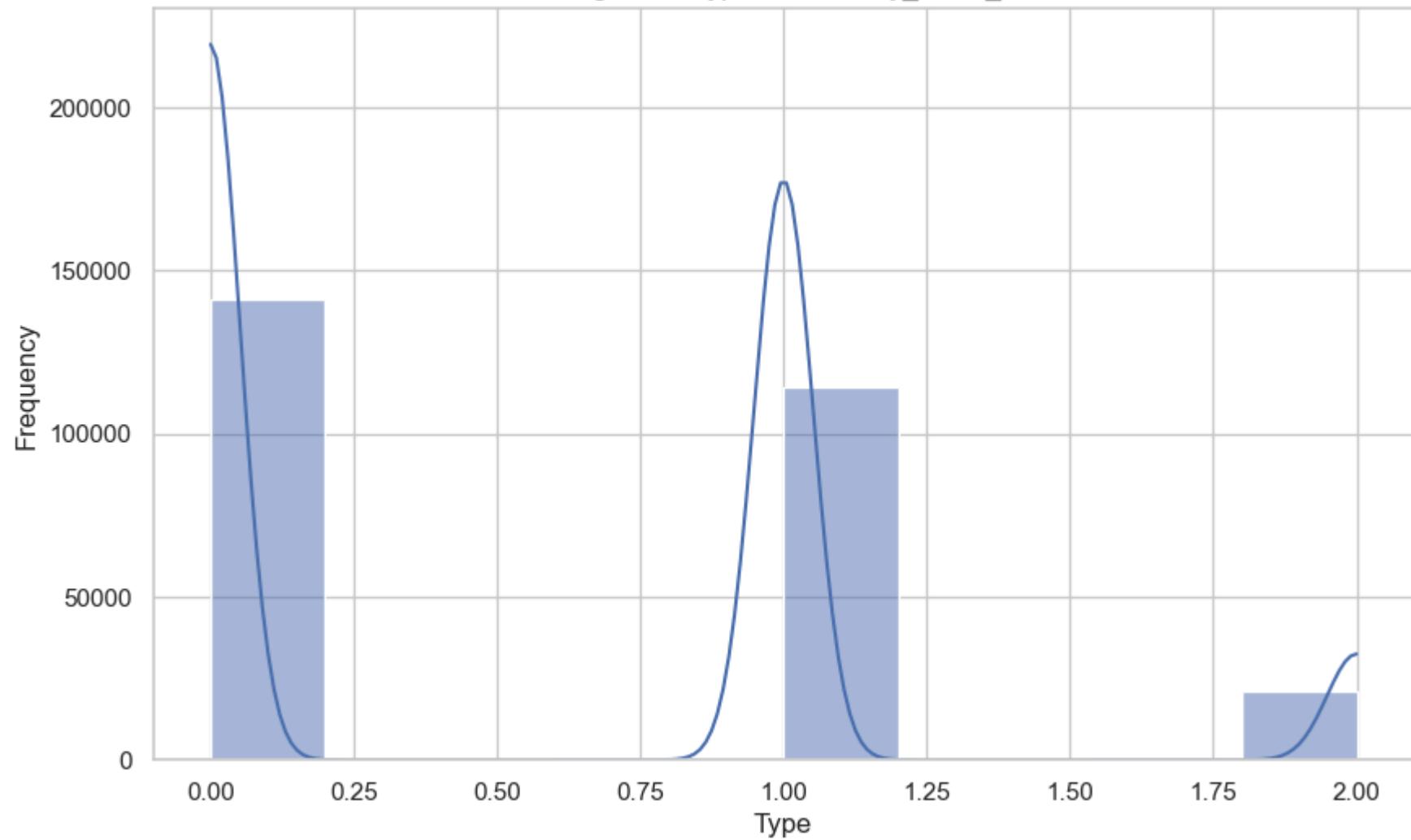


Box Plot of Unemployment in Data with Weekly_Sales_2w

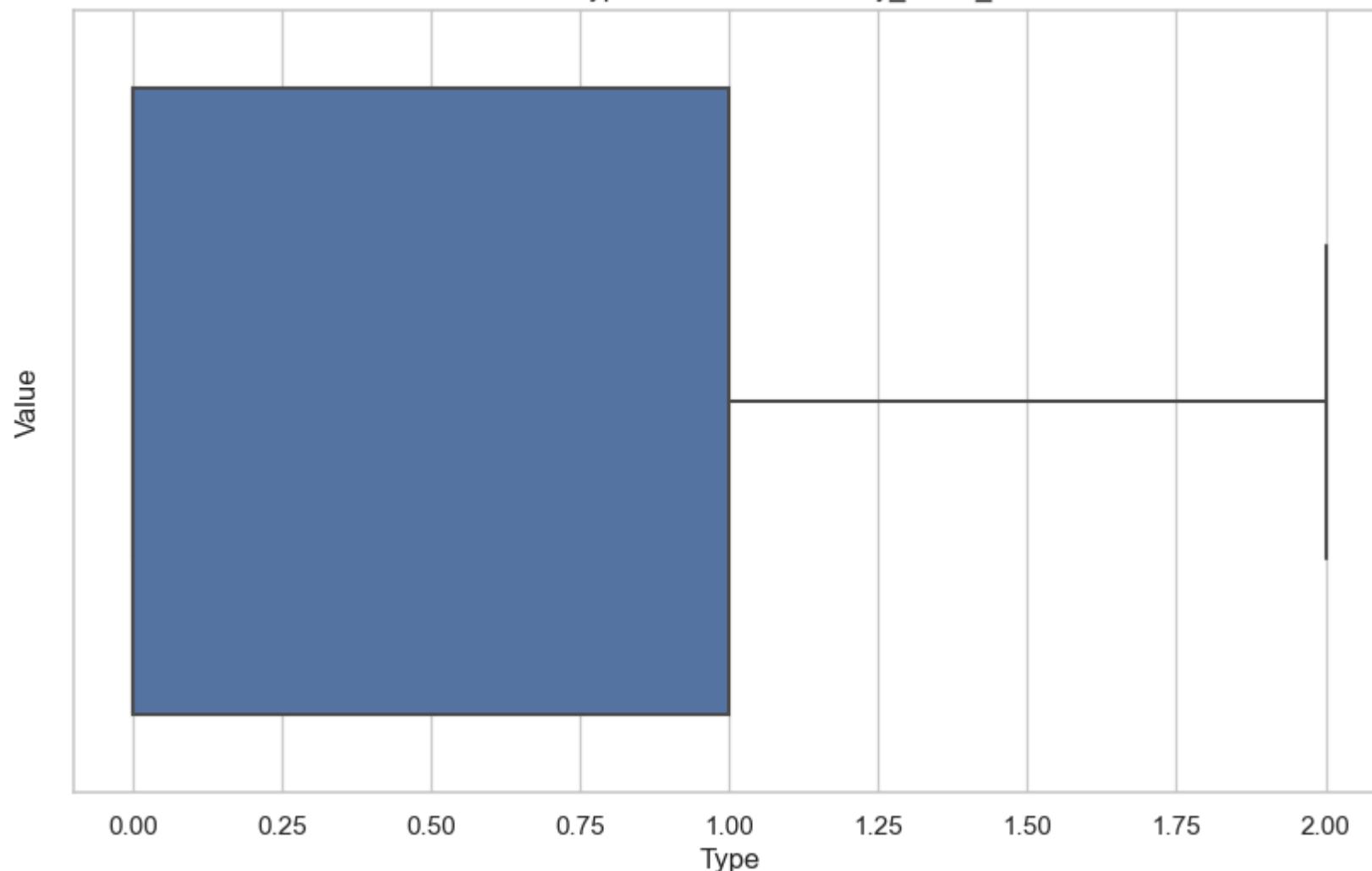


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_2w

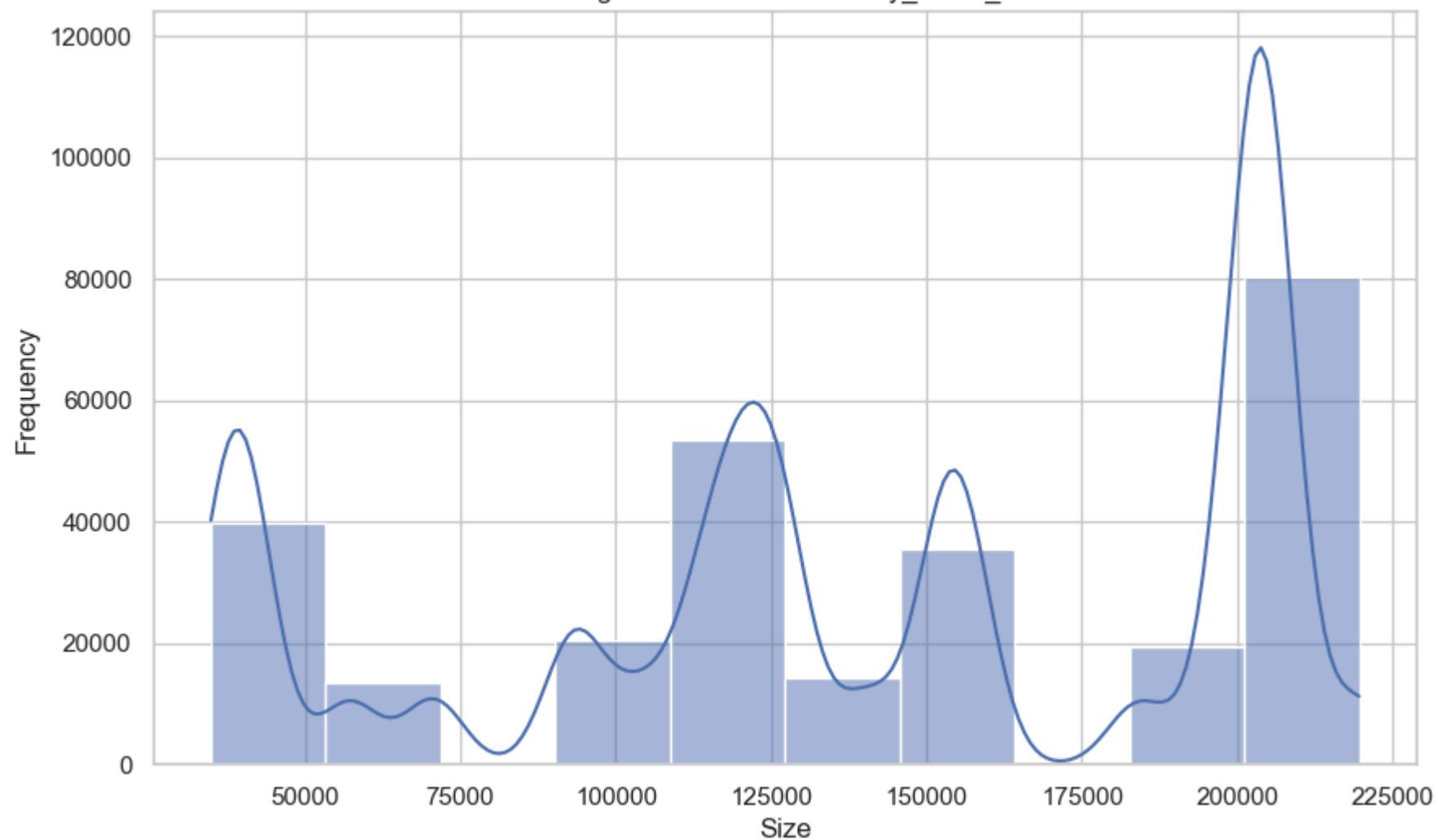


Box Plot of Type in Data with Weekly_Sales_2w

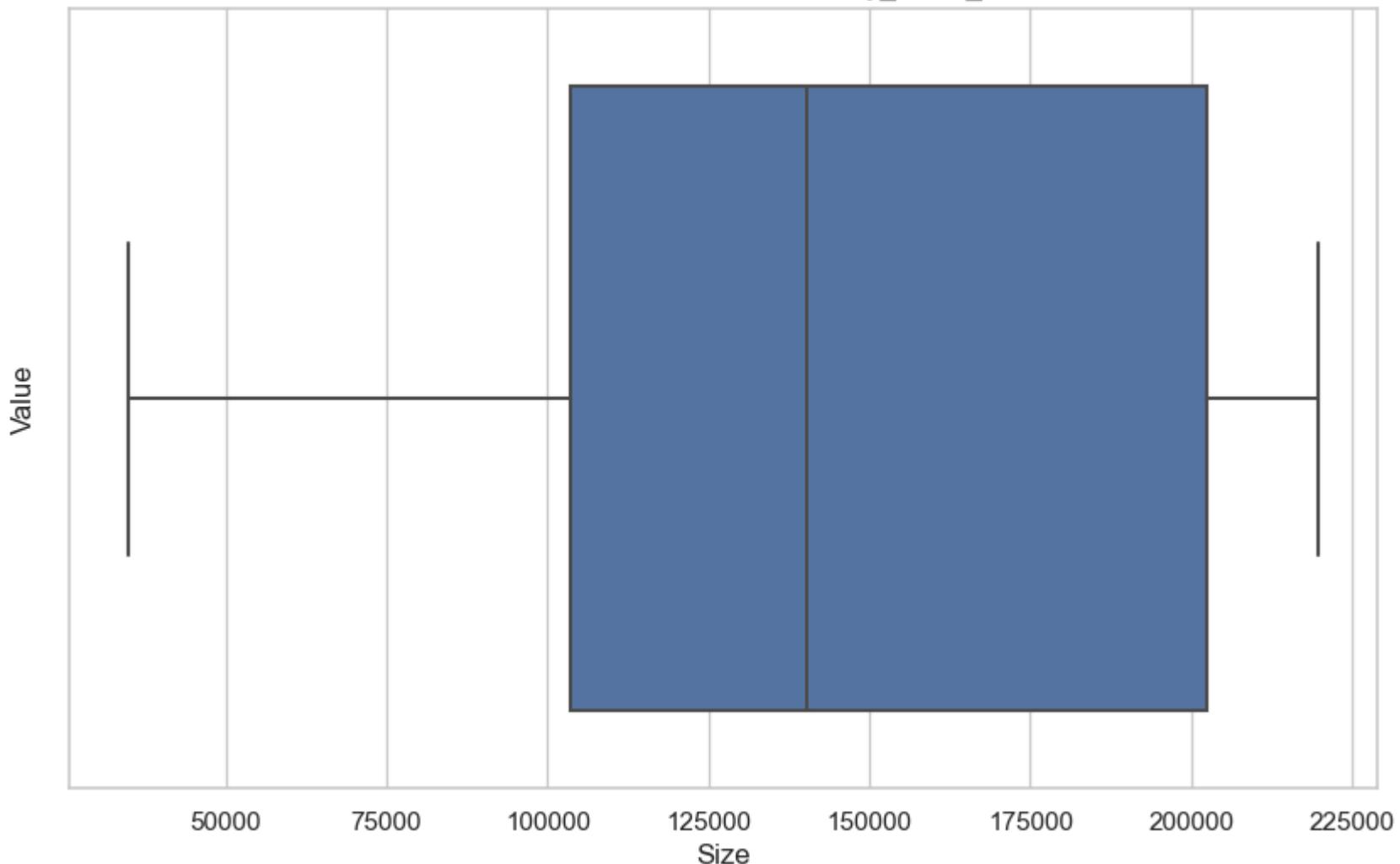


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_2w

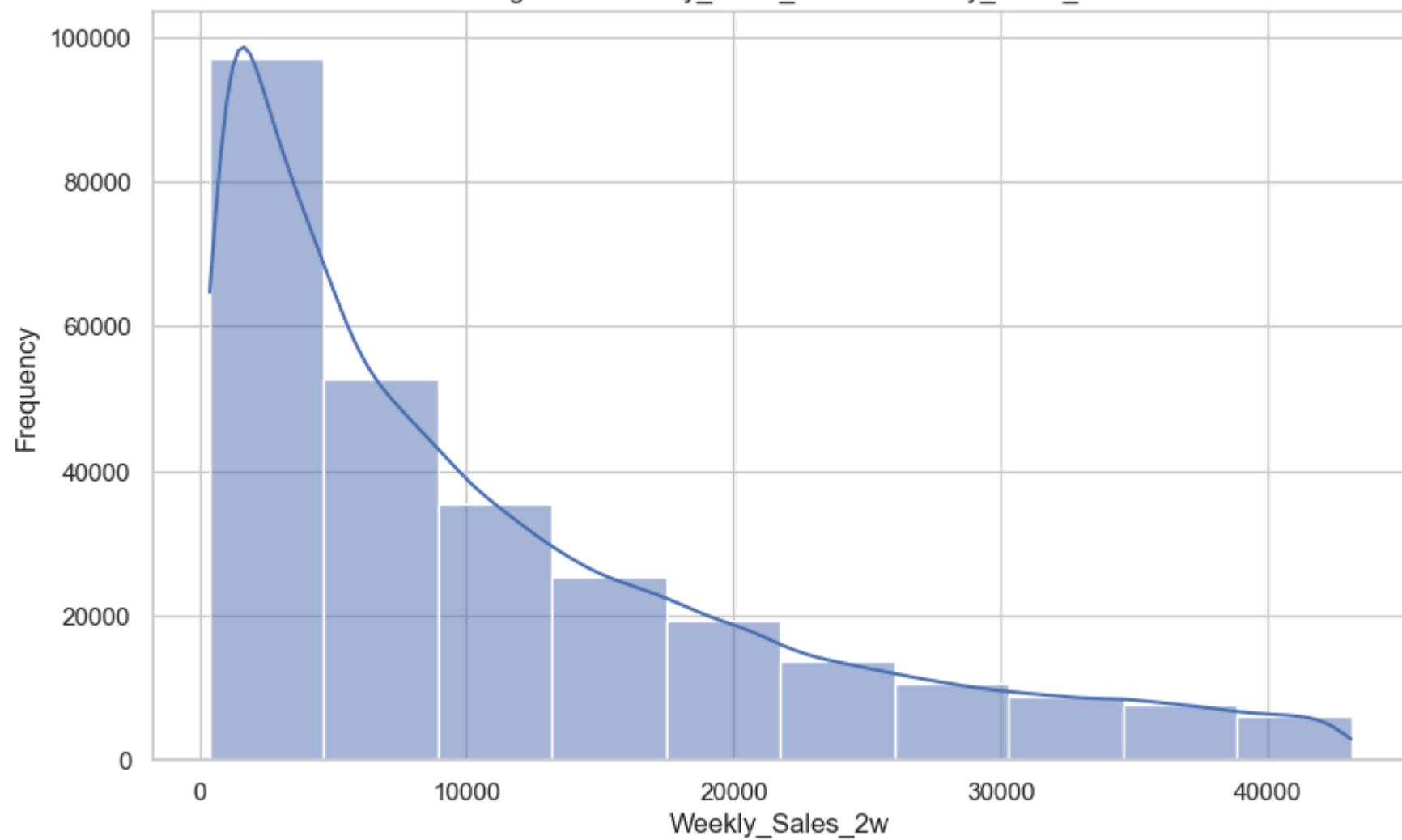


Box Plot of Size in Data with Weekly_Sales_2w

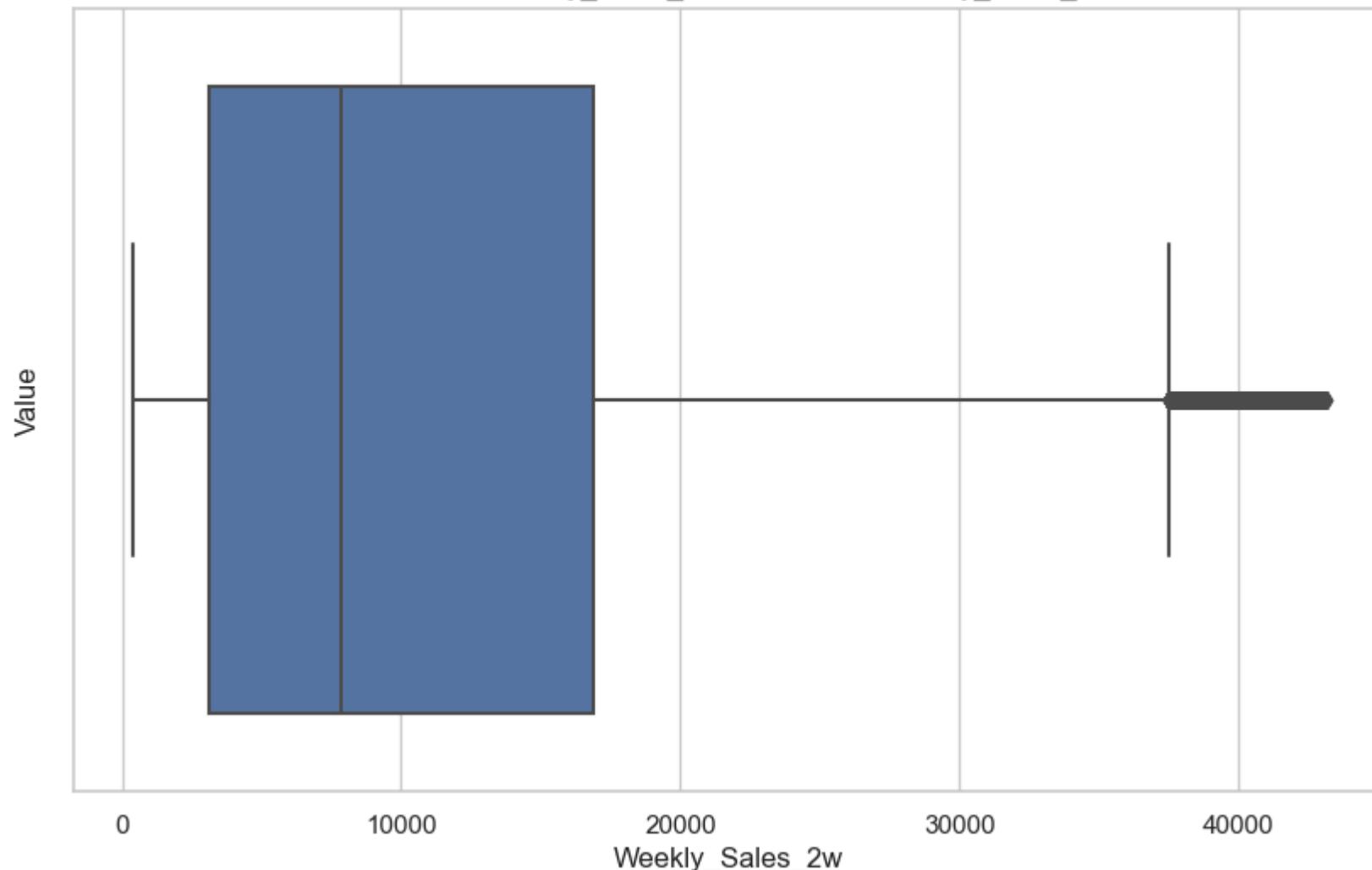


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_2w with Weekly_Sales_2w

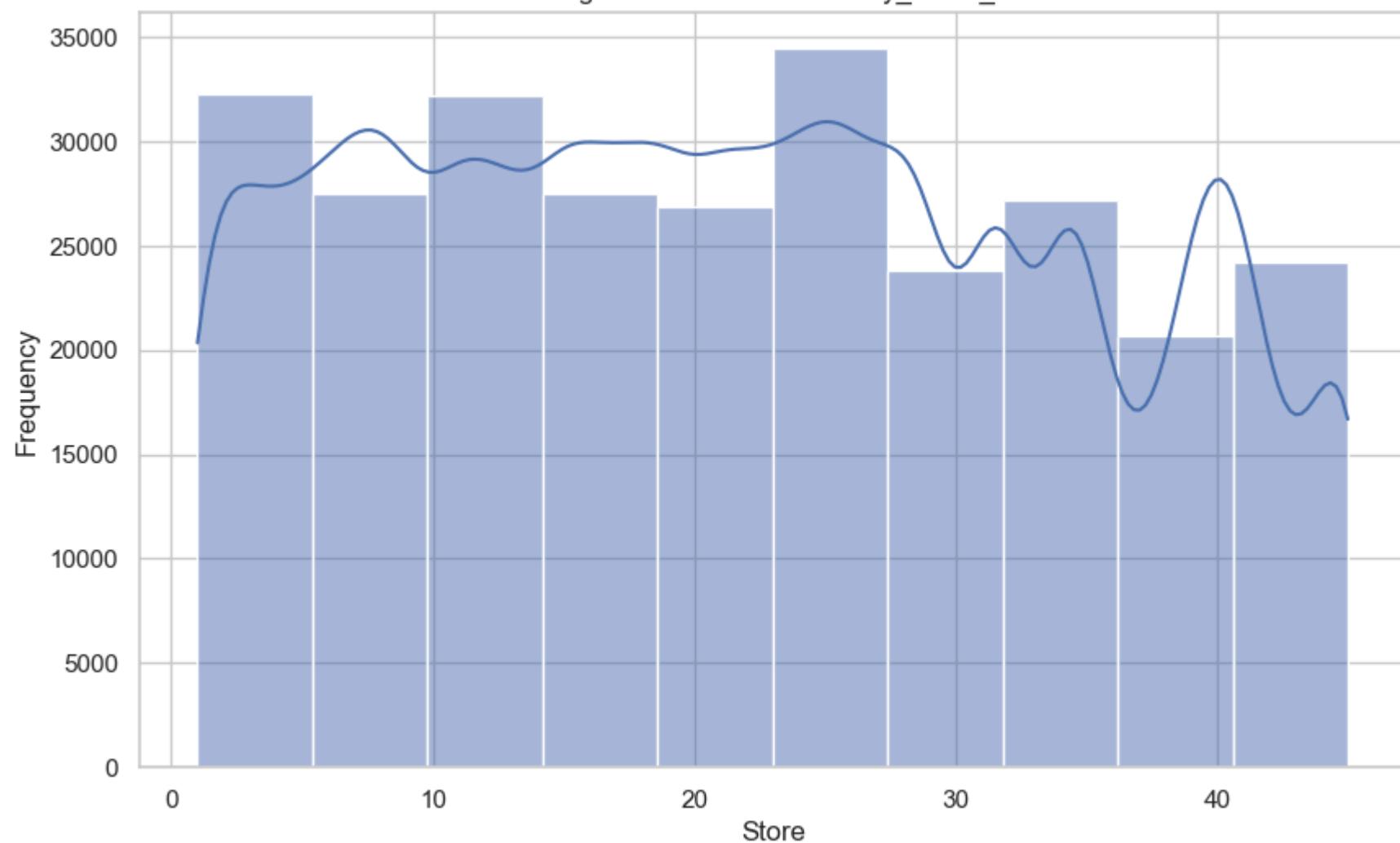


Box Plot of Weekly_Sales_2w in Data with Weekly_Sales_2w

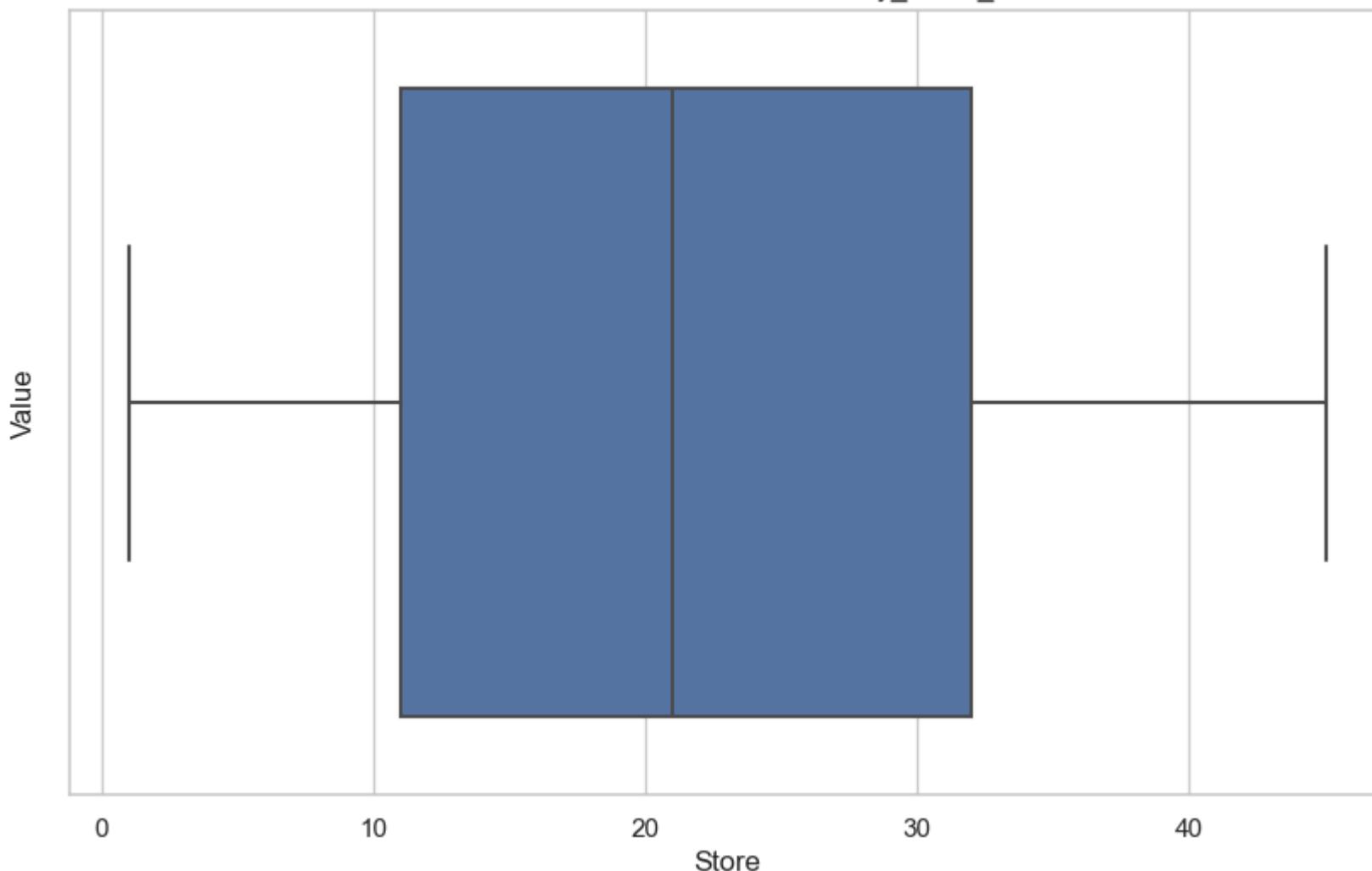


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_3w

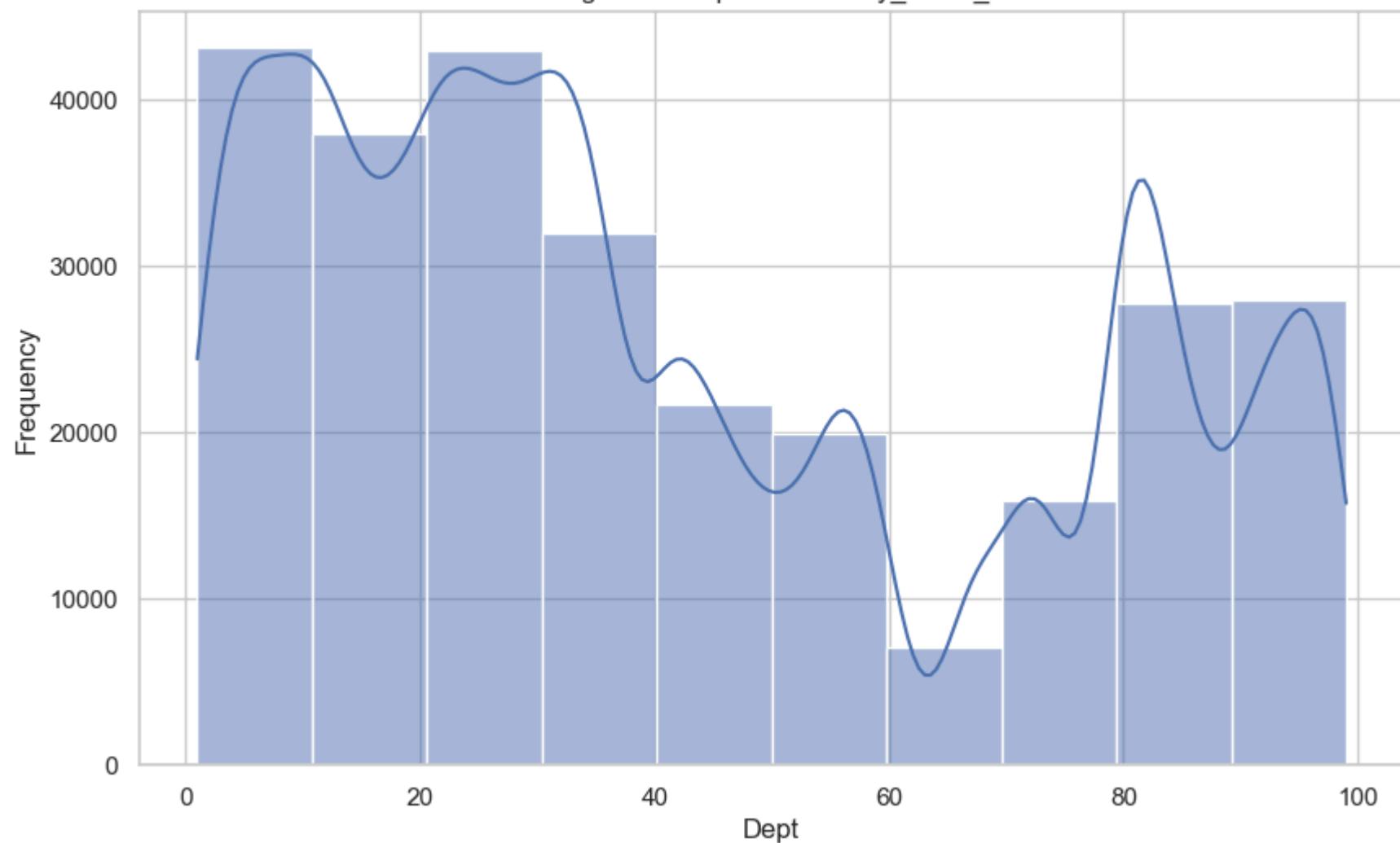


Box Plot of Store in Data with Weekly_Sales_3w

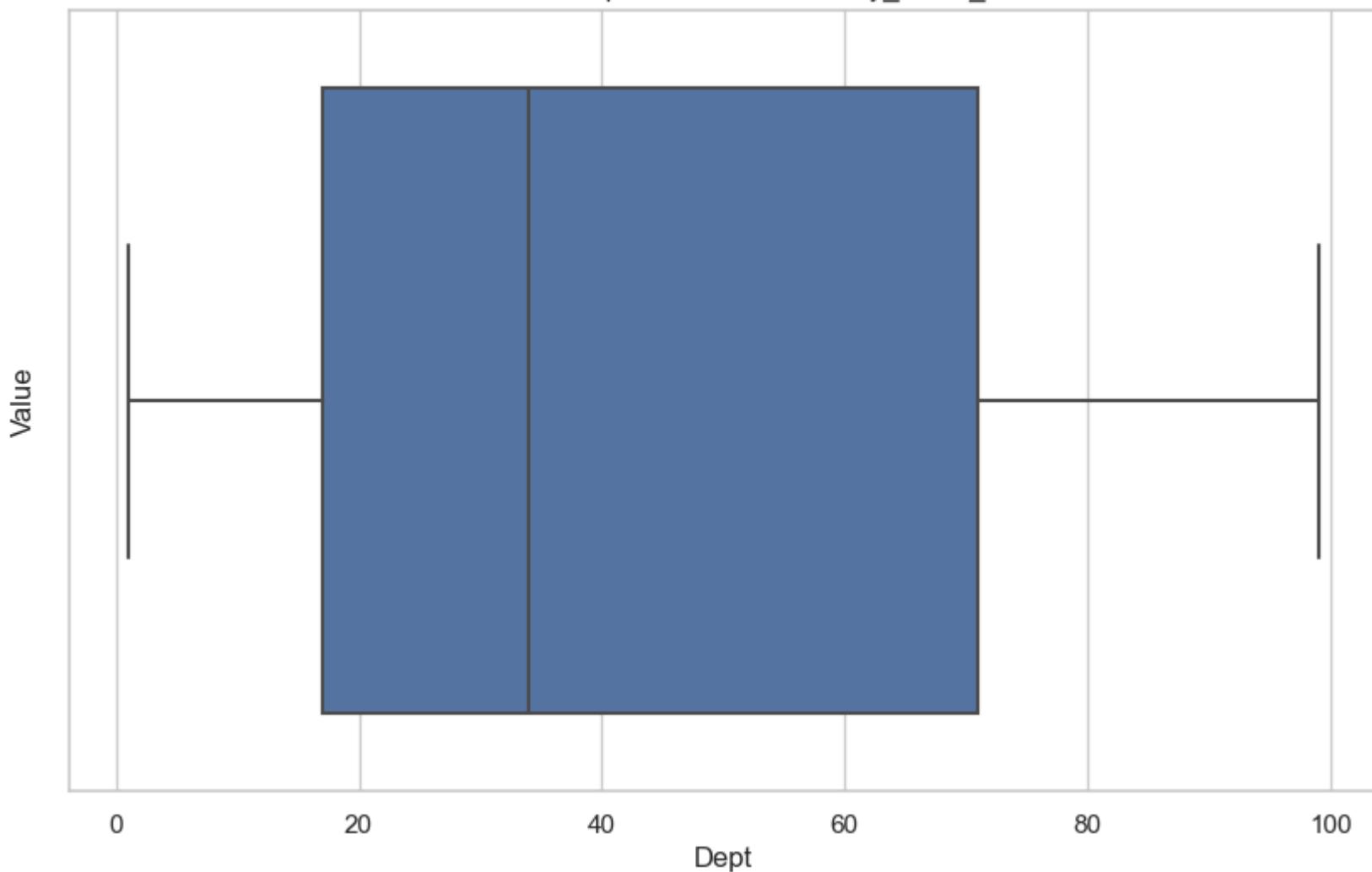


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_3w

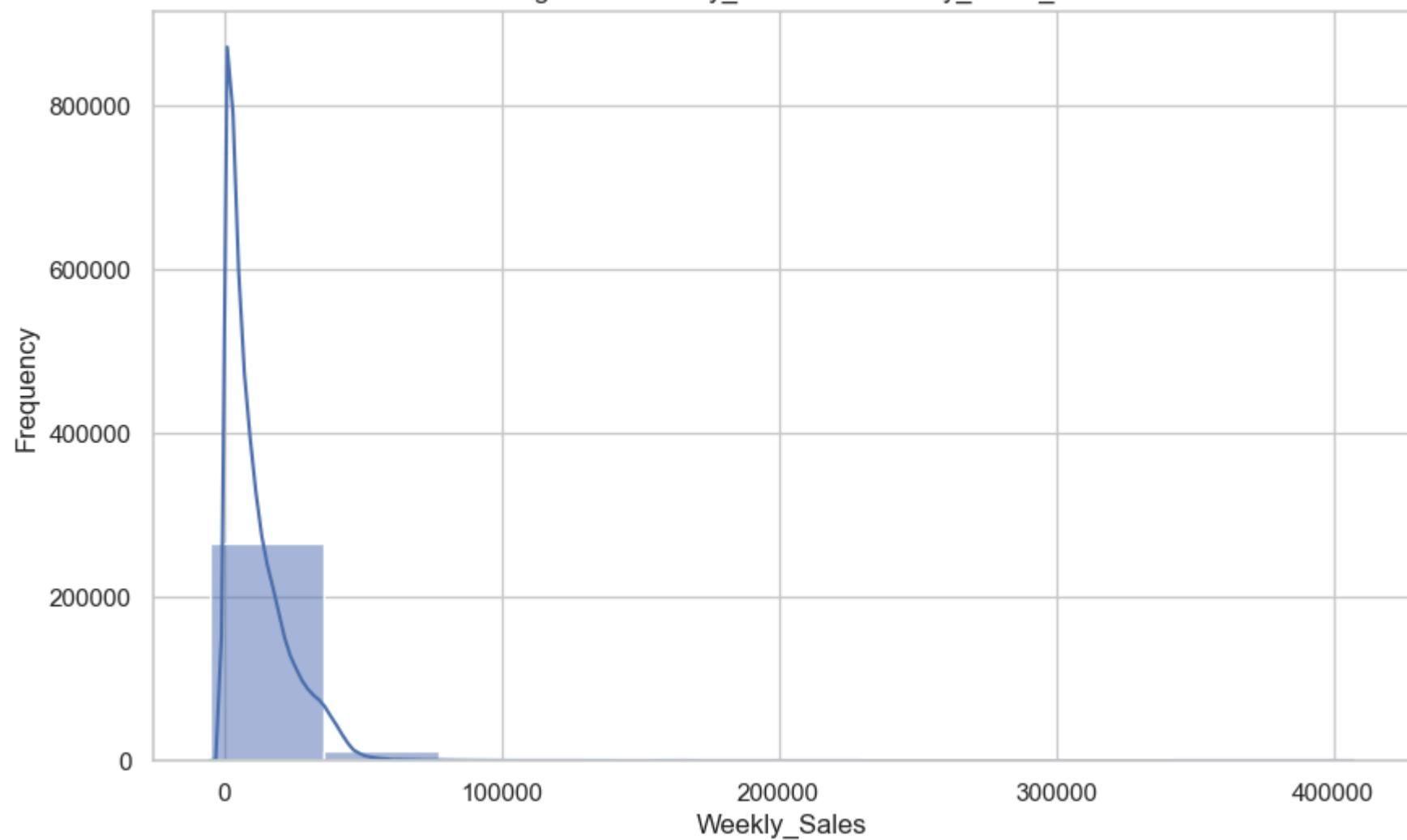


Box Plot of Dept in Data with Weekly_Sales_3w

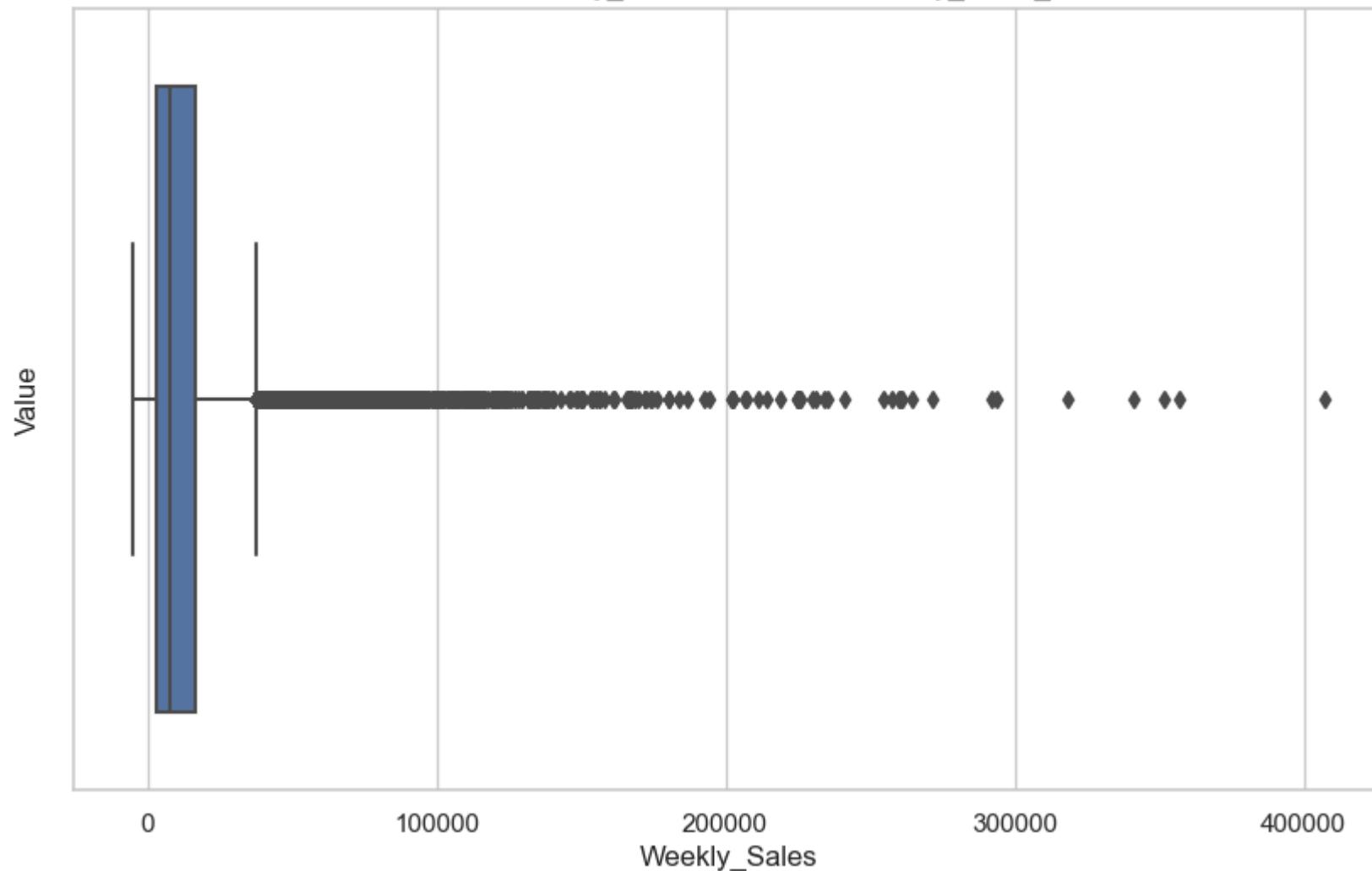


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_3w

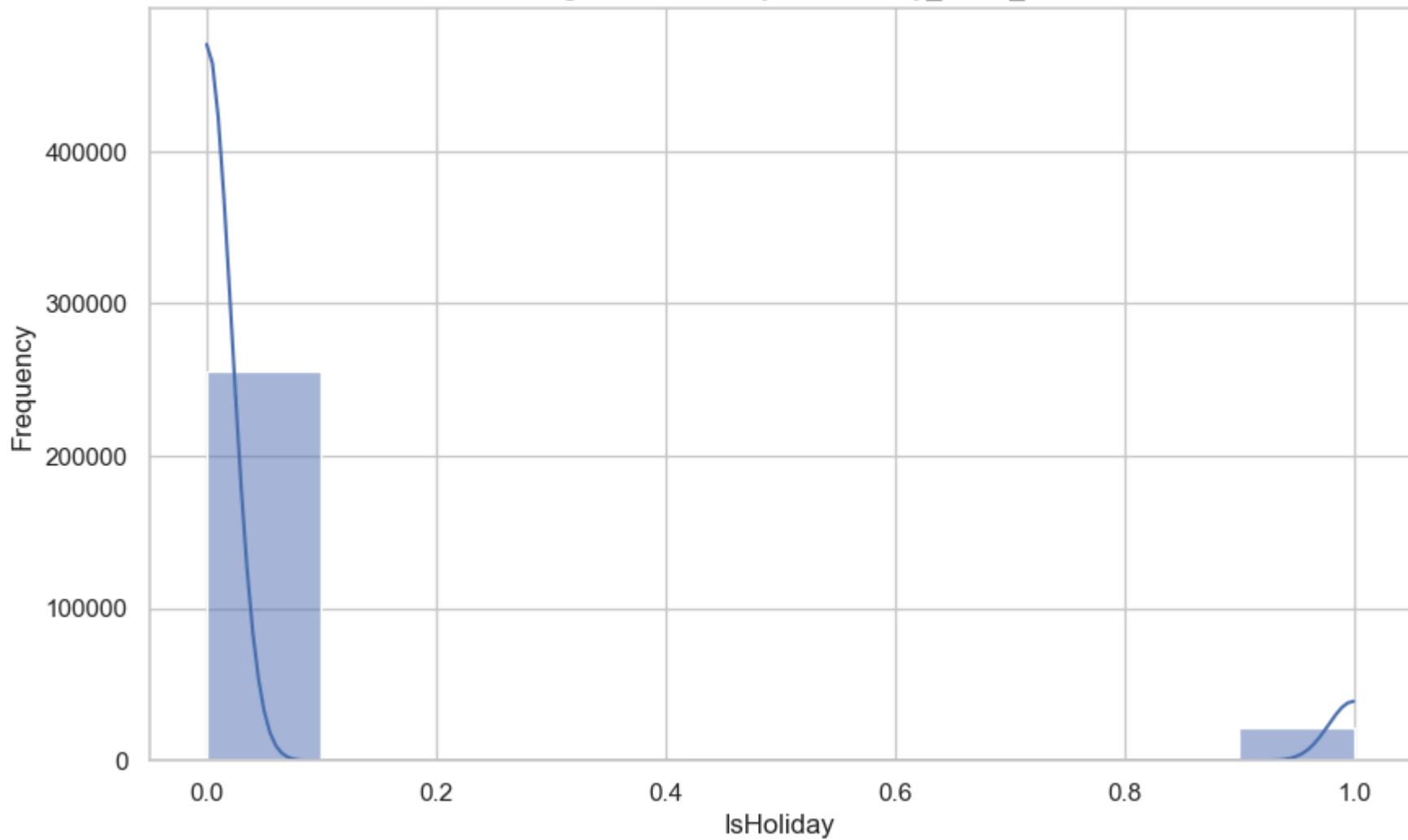


Box Plot of Weekly_Sales in Data with Weekly_Sales_3w

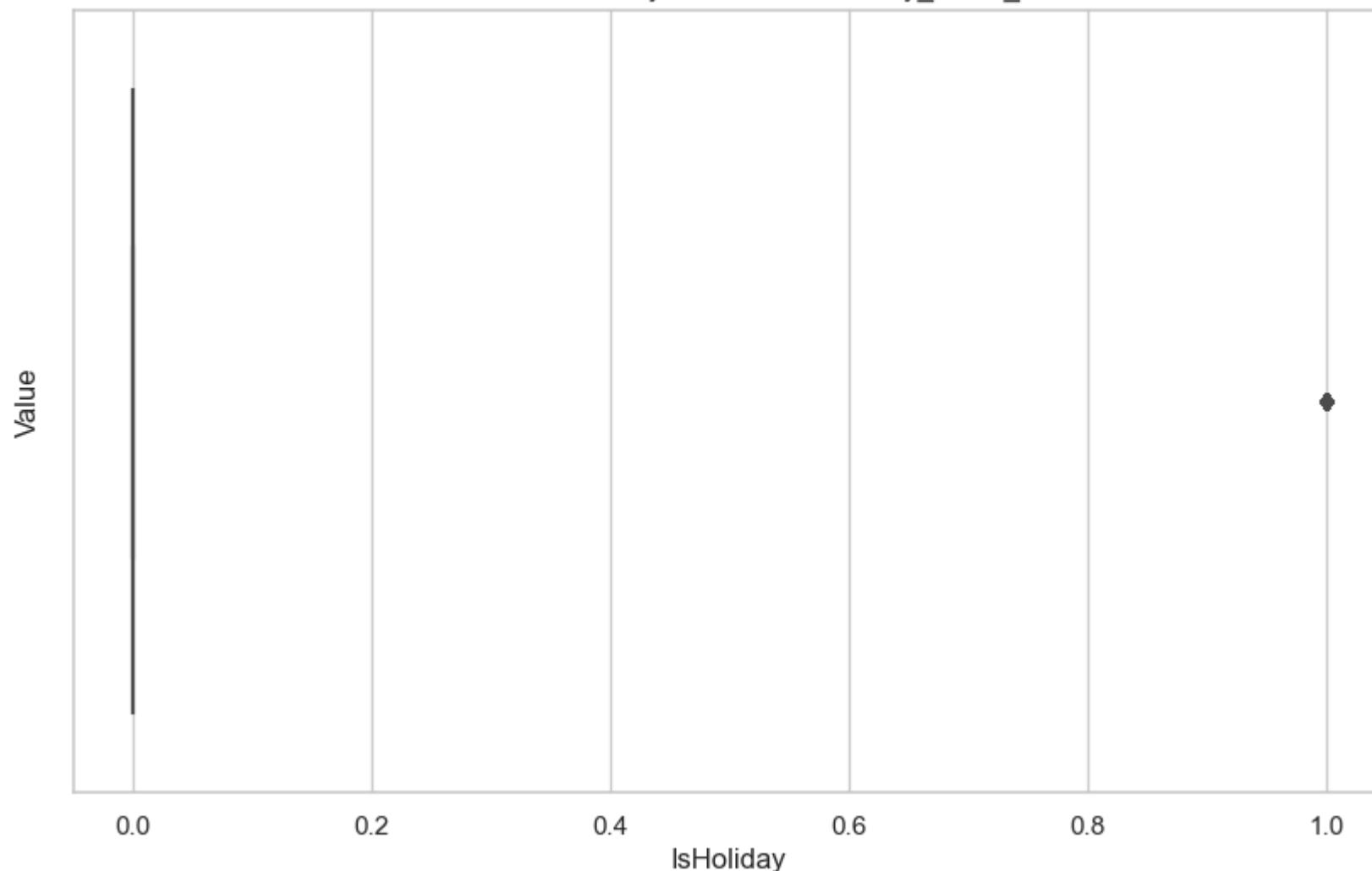


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_3w

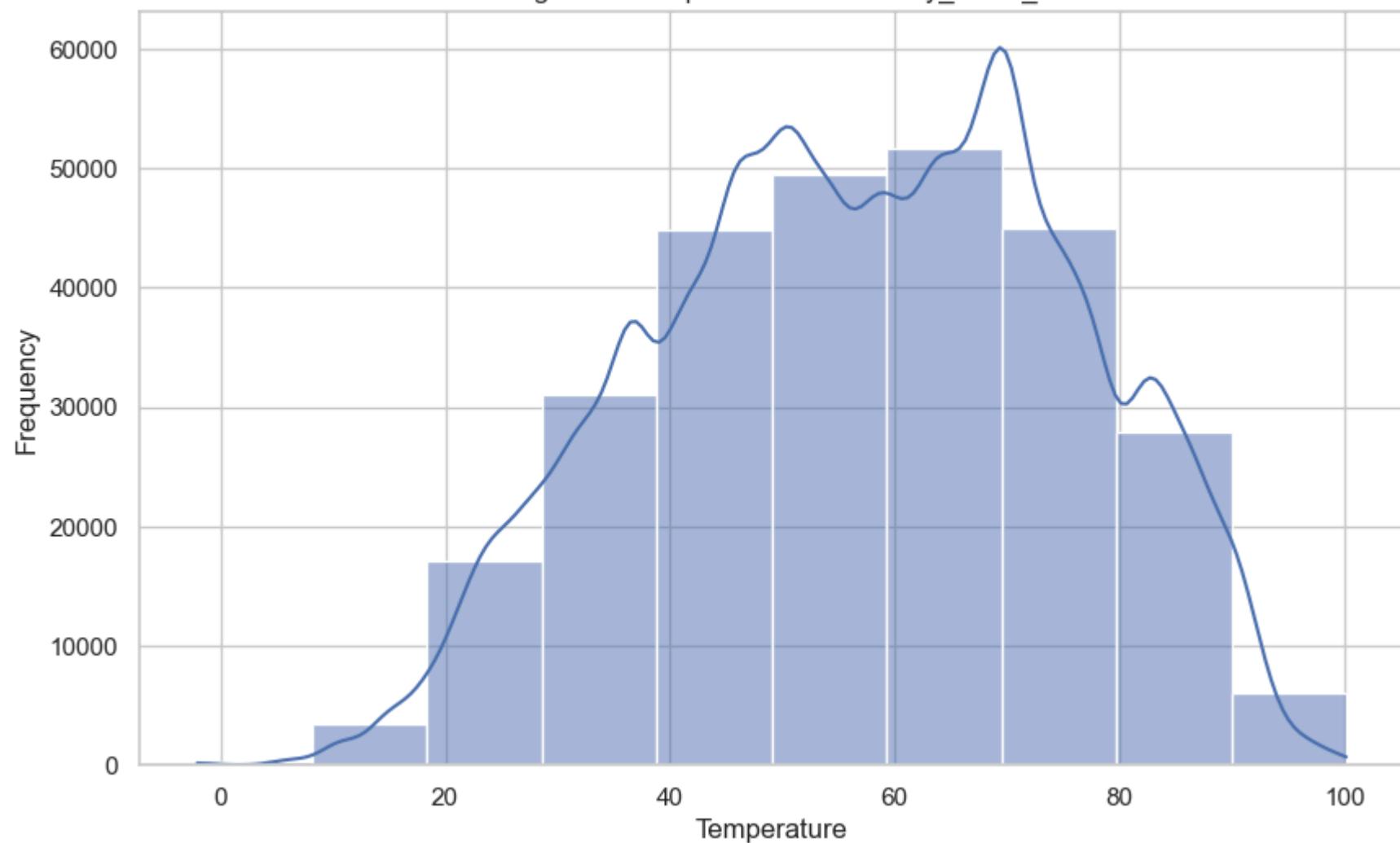


Box Plot of IsHoliday in Data with Weekly_Sales_3w

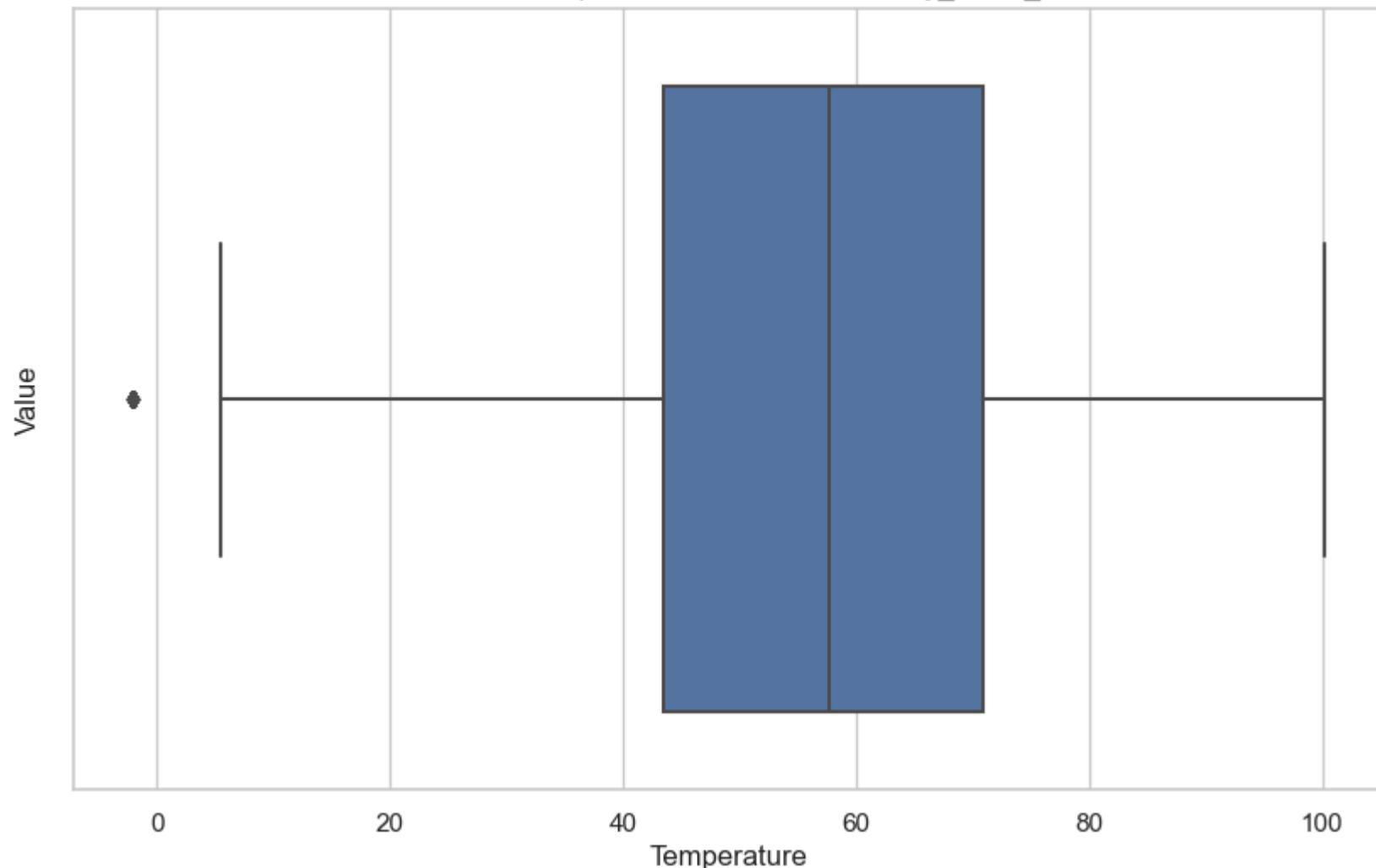


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_3w

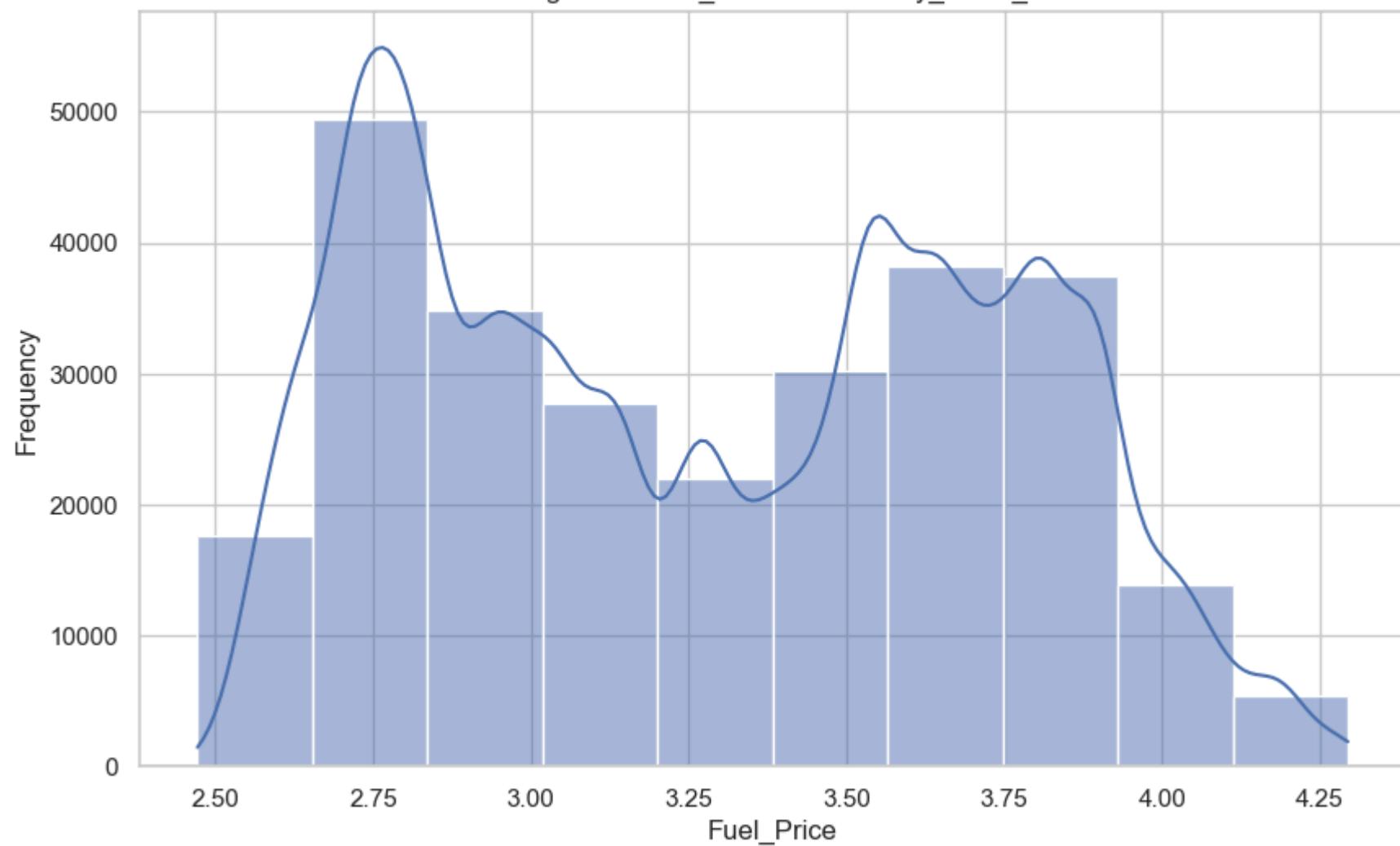


Box Plot of Temperature in Data with Weekly_Sales_3w

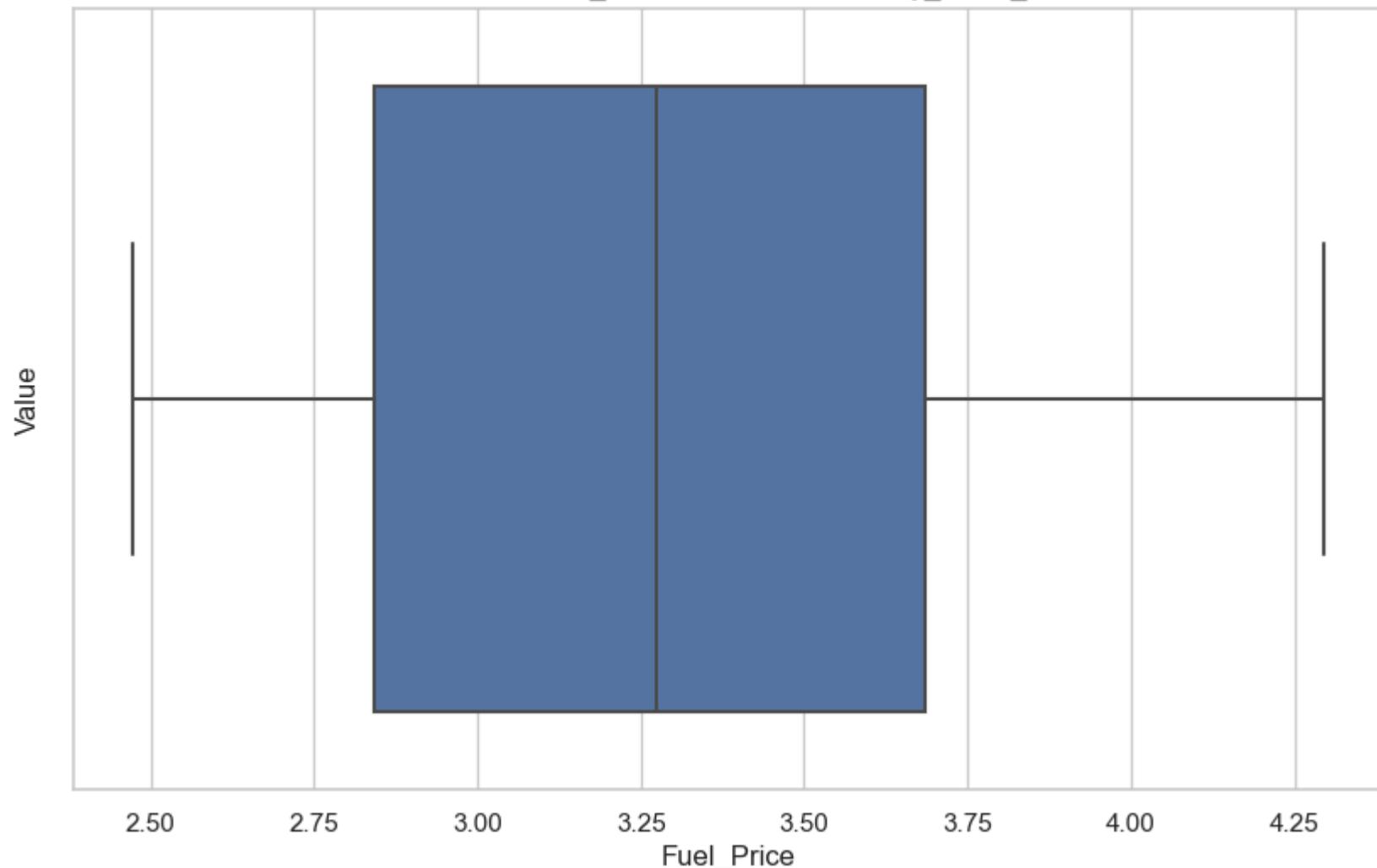


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

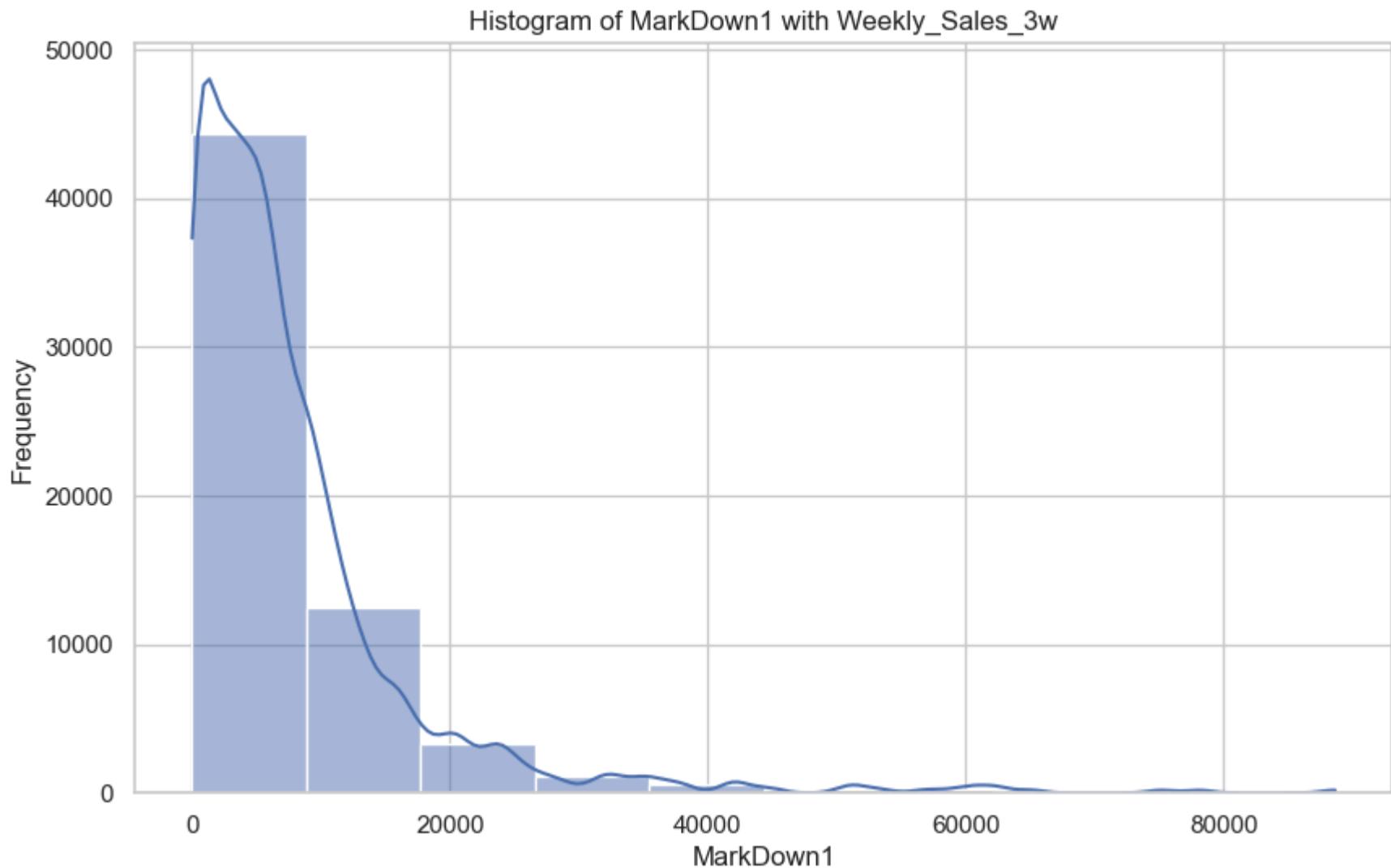
Histogram of Fuel_Price with Weekly_Sales_3w



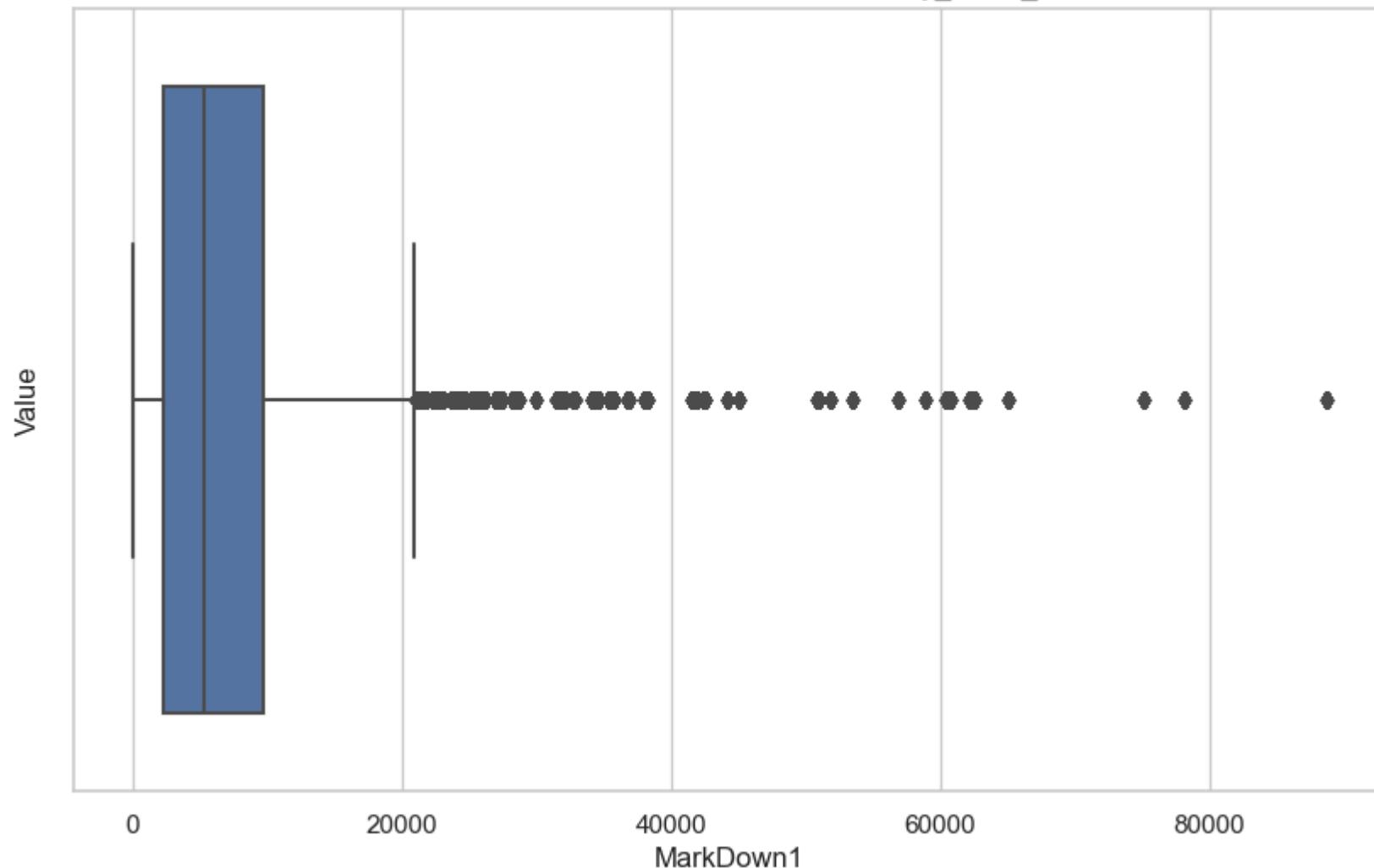
Box Plot of Fuel_Price in Data with Weekly_Sales_3w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

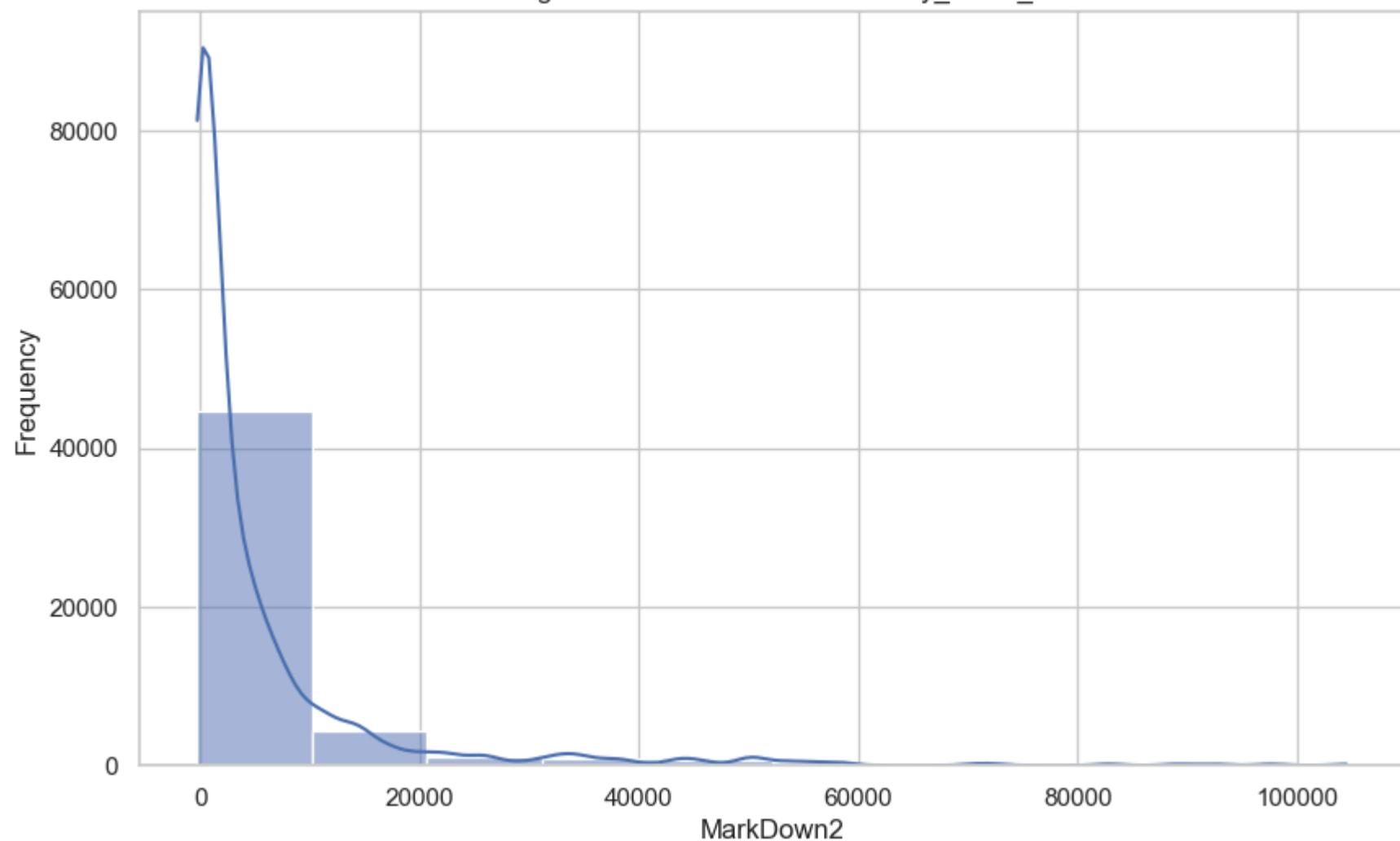


Box Plot of MarkDown1 in Data with Weekly_Sales_3w

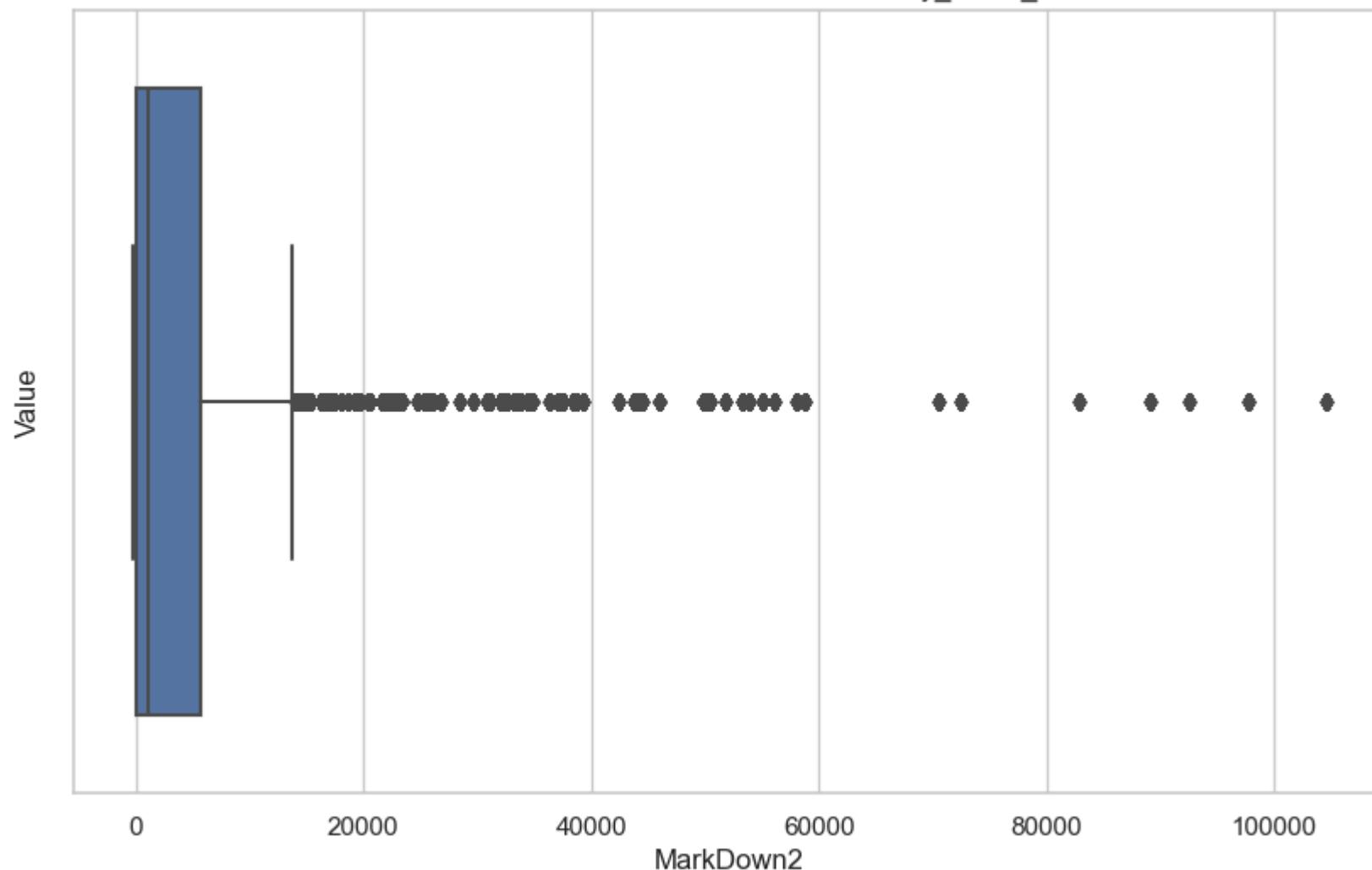


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_3w

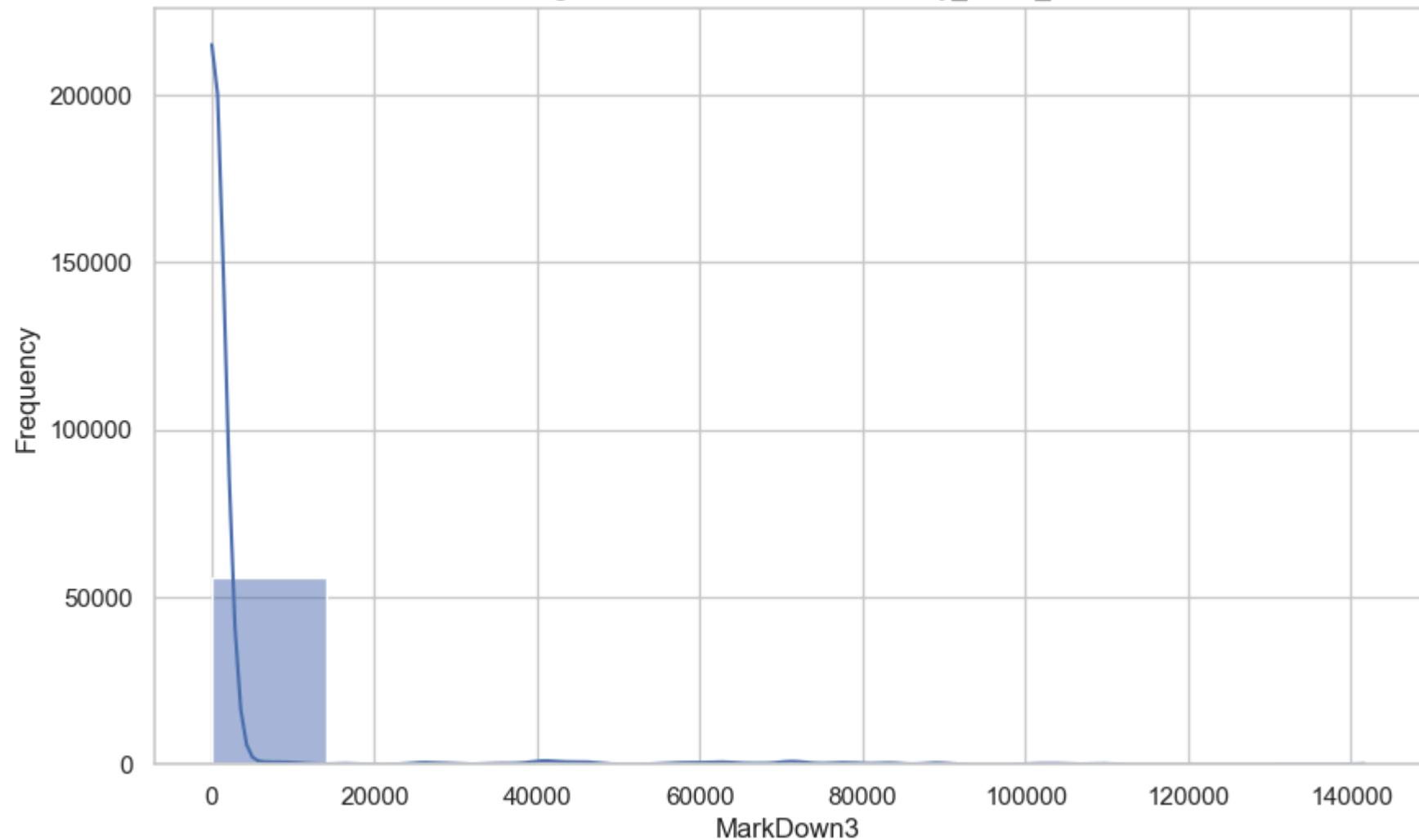


Box Plot of MarkDown2 in Data with Weekly_Sales_3w

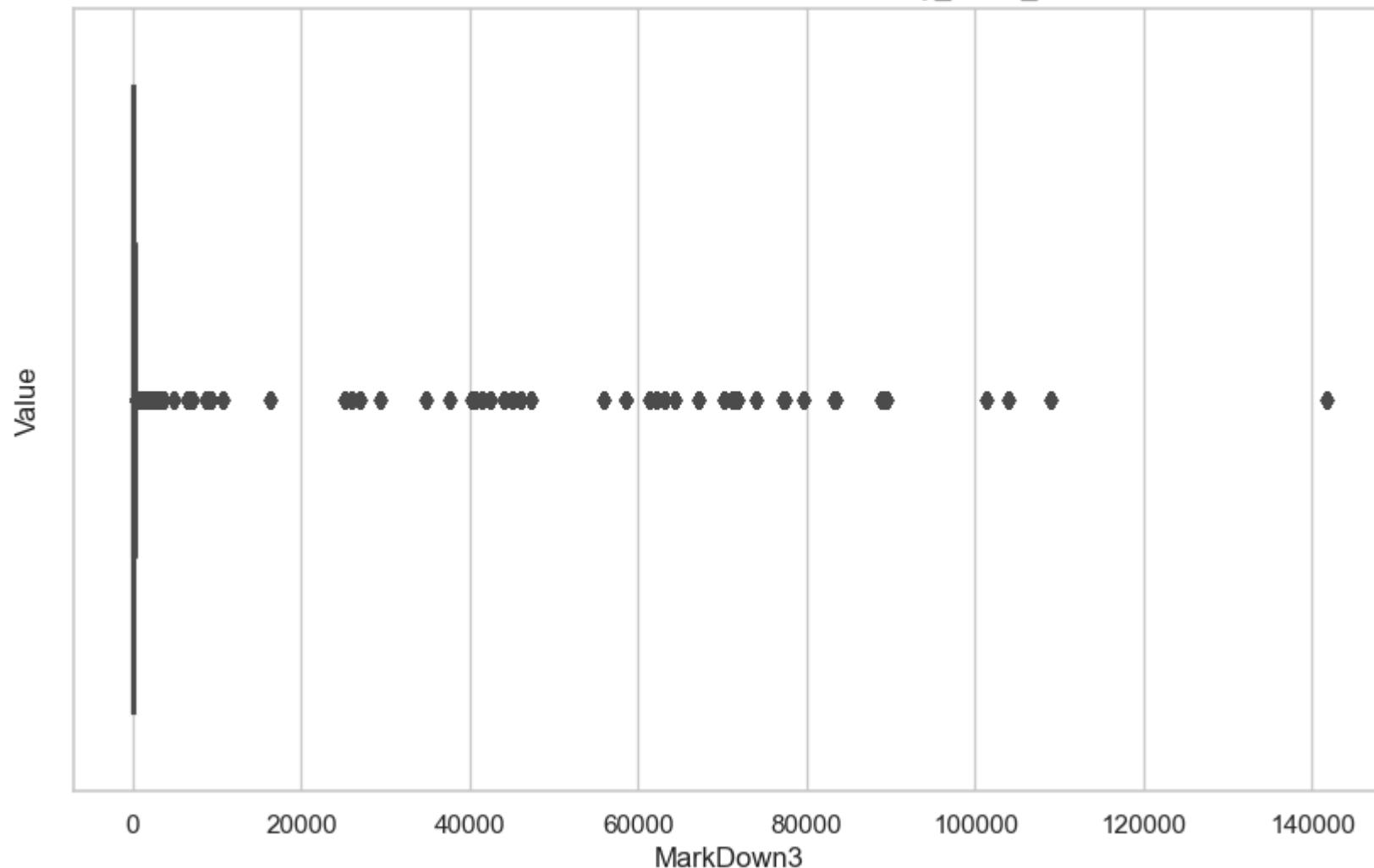


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_3w

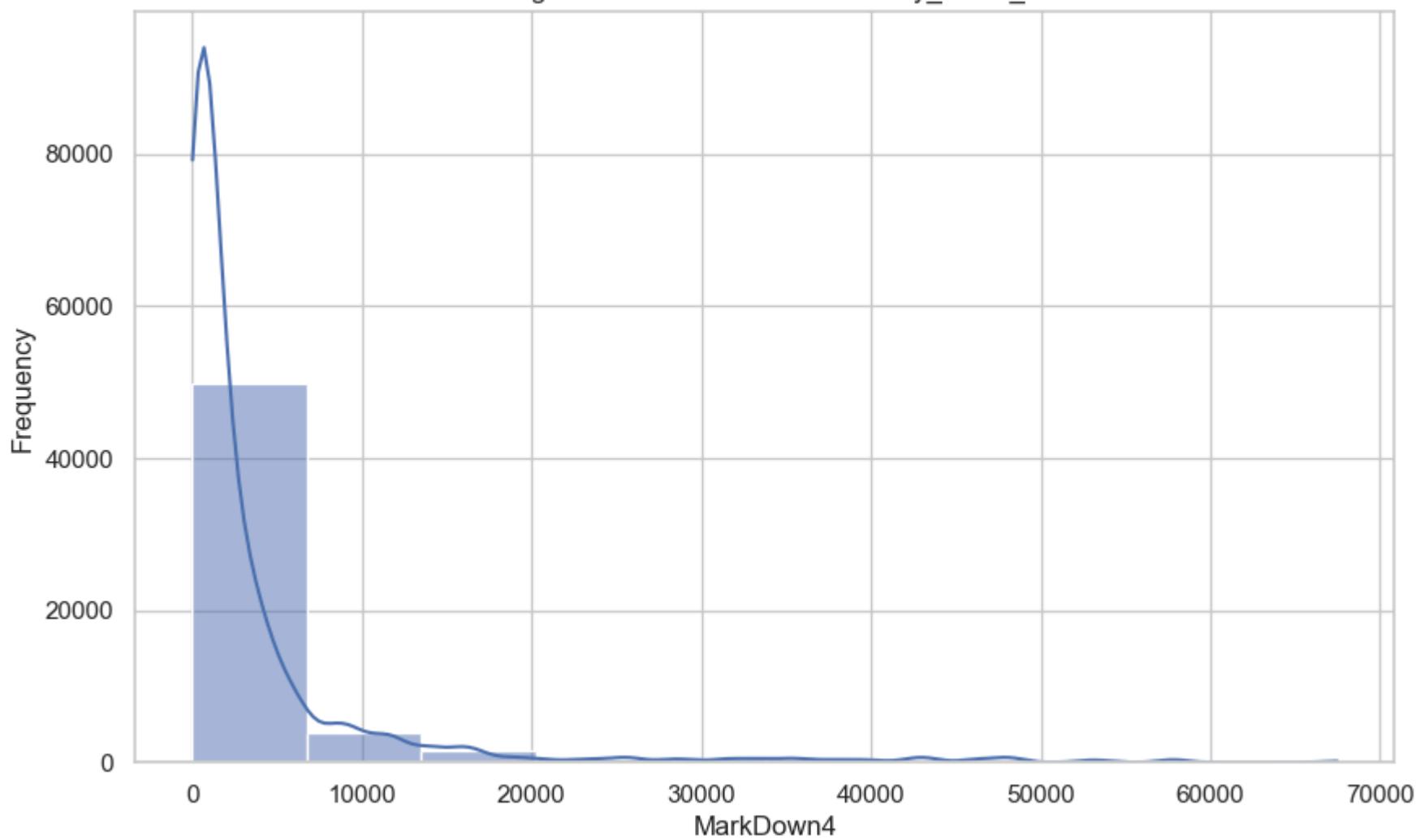


Box Plot of MarkDown3 in Data with Weekly_Sales_3w

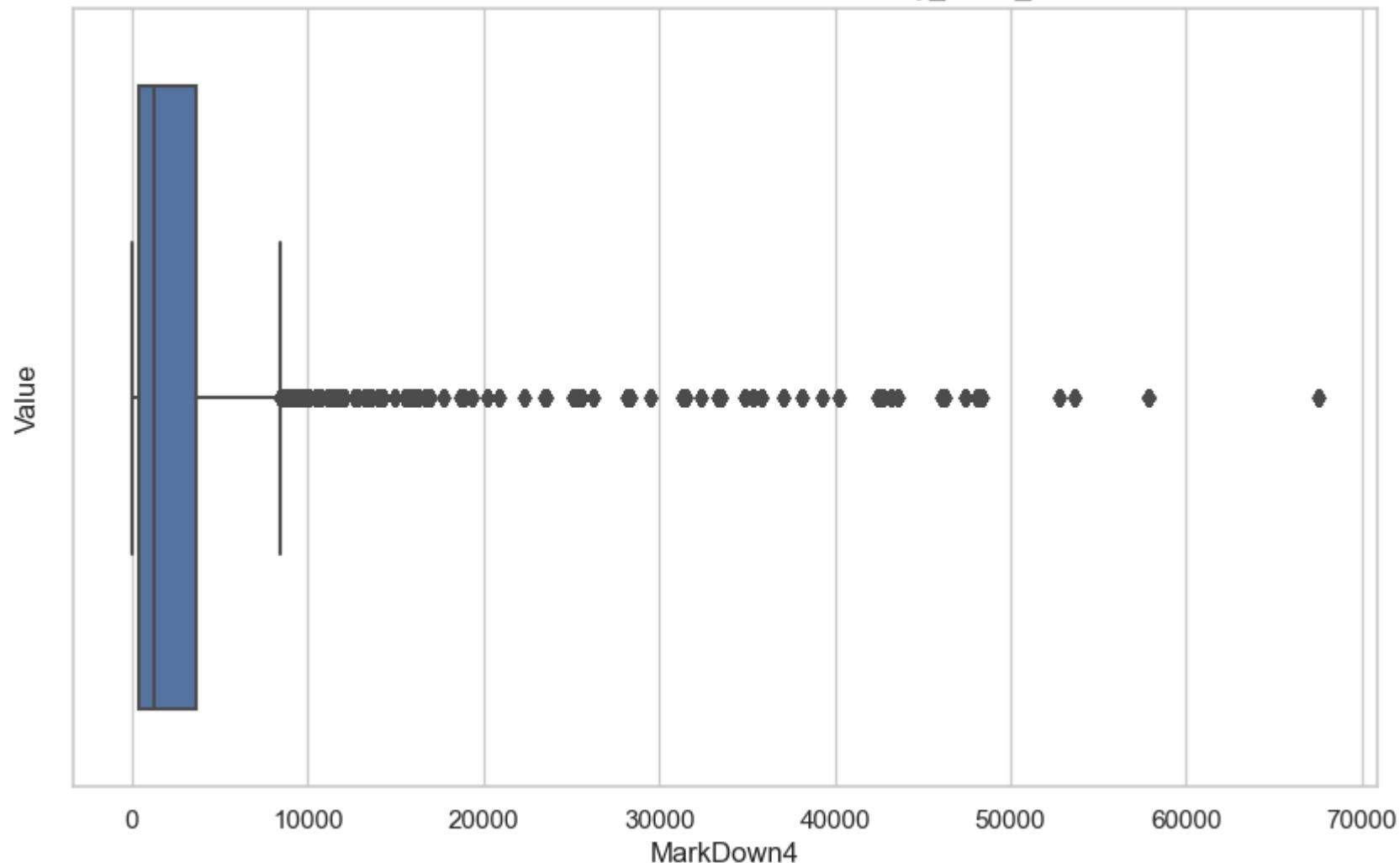


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_3w

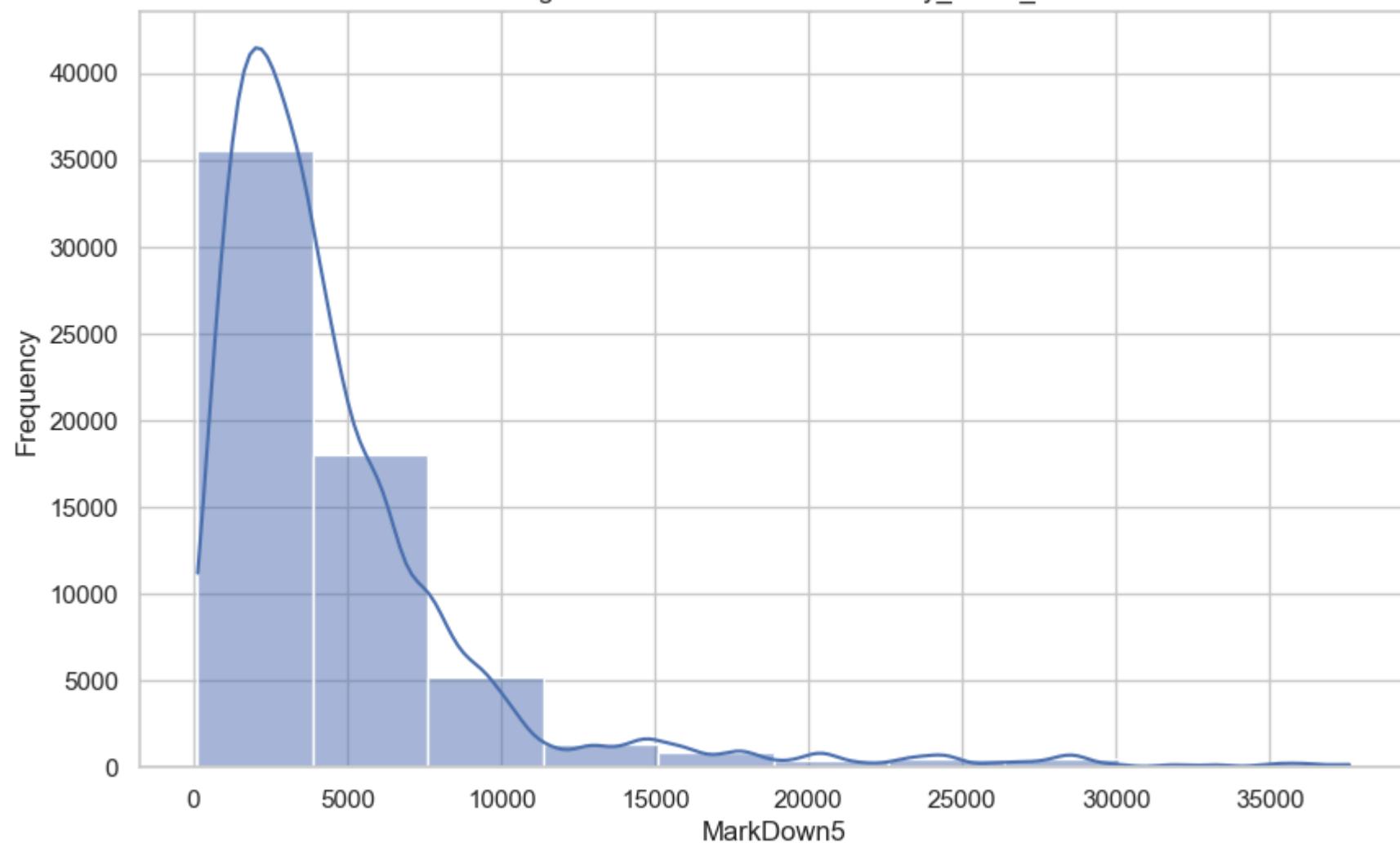


Box Plot of MarkDown4 in Data with Weekly_Sales_3w

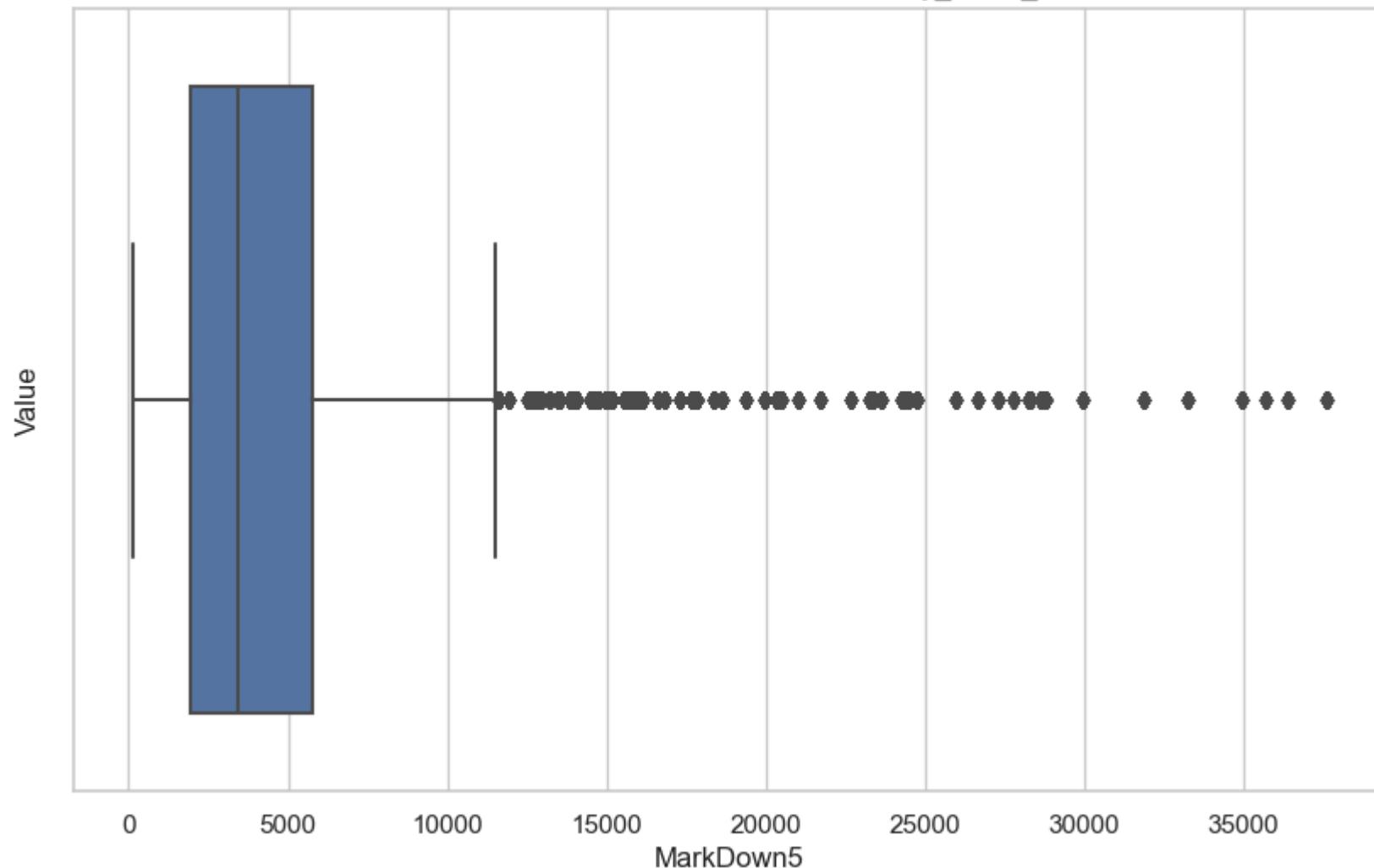


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_3w

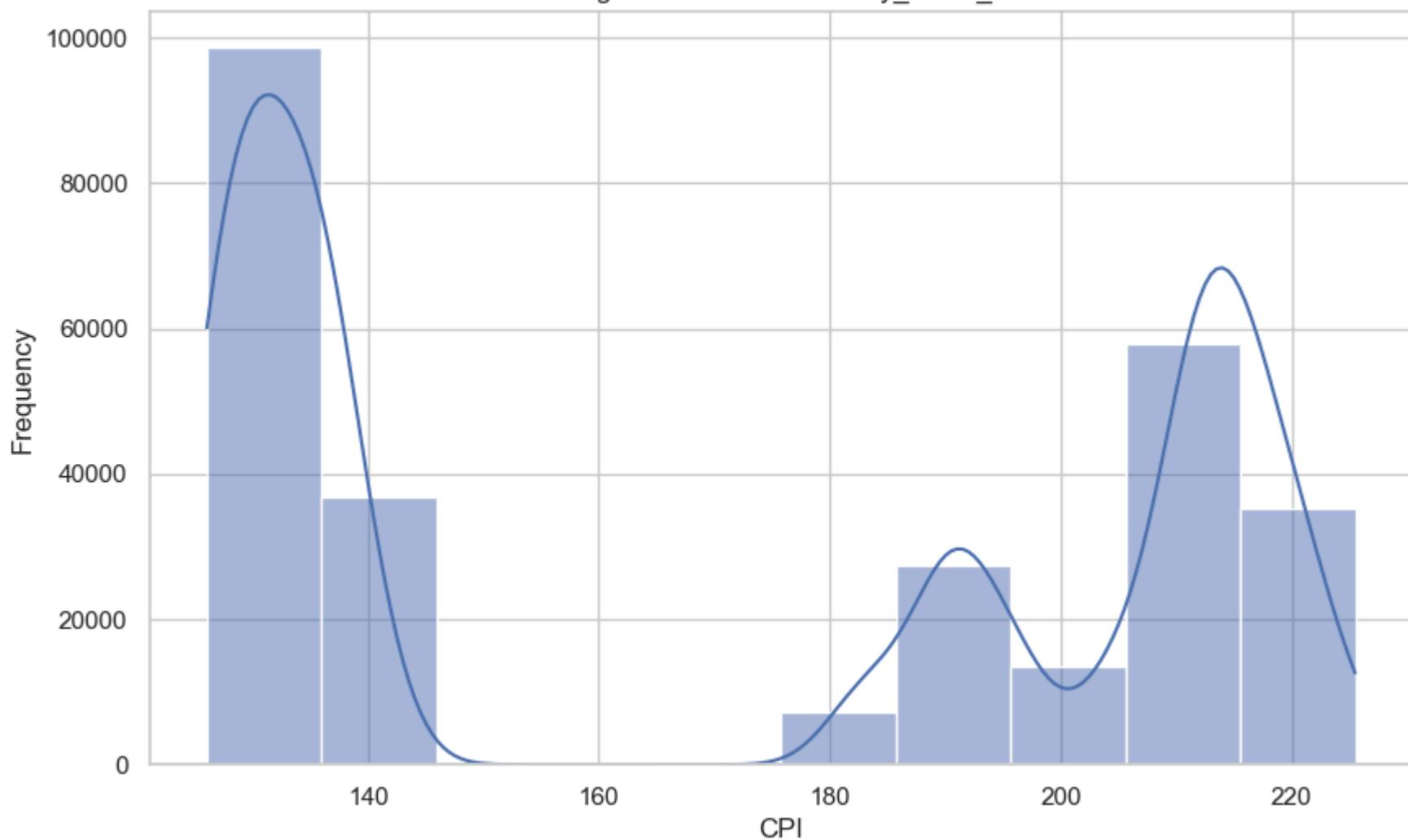


Box Plot of MarkDown5 in Data with Weekly_Sales_3w

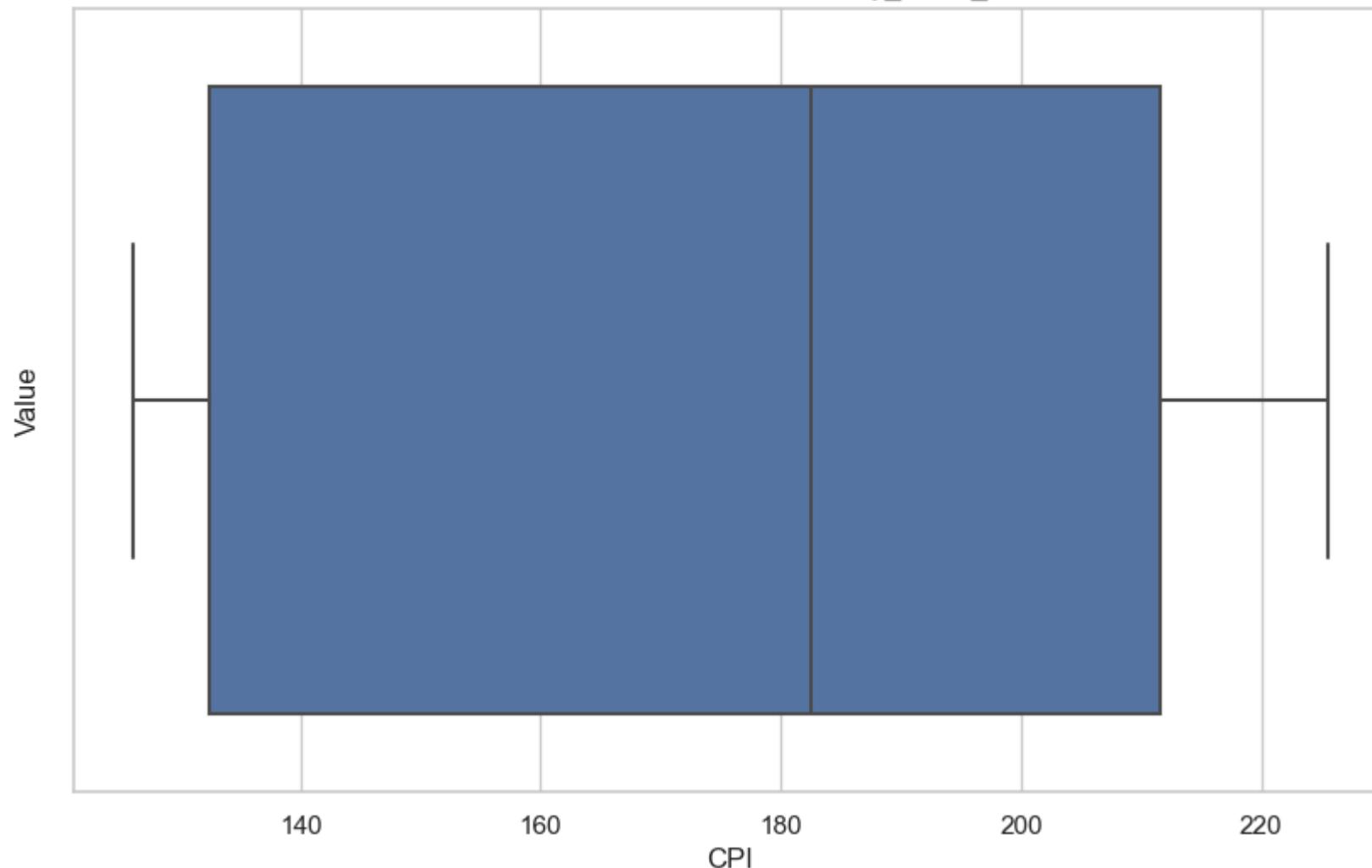


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_3w

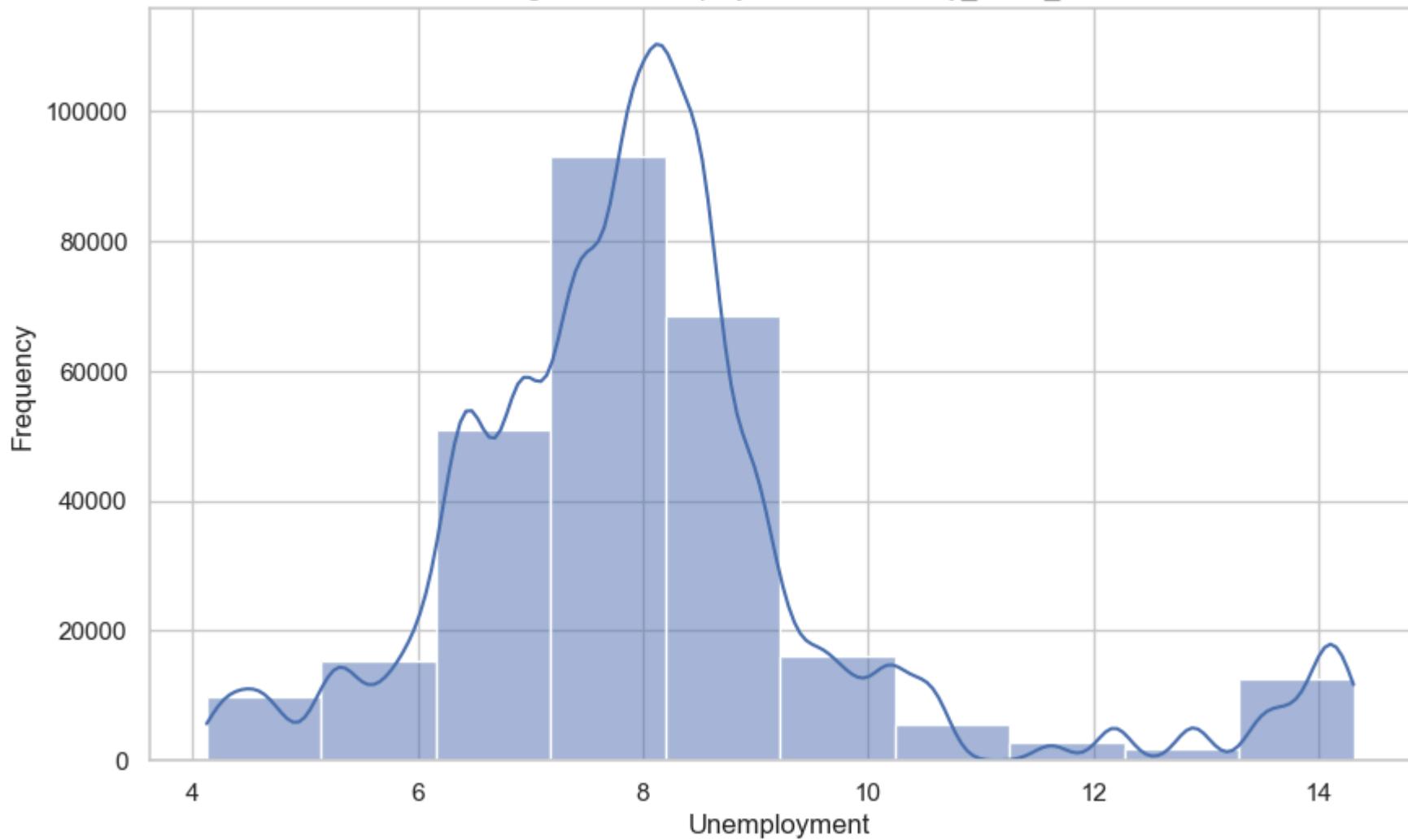


Box Plot of CPI in Data with Weekly_Sales_3w

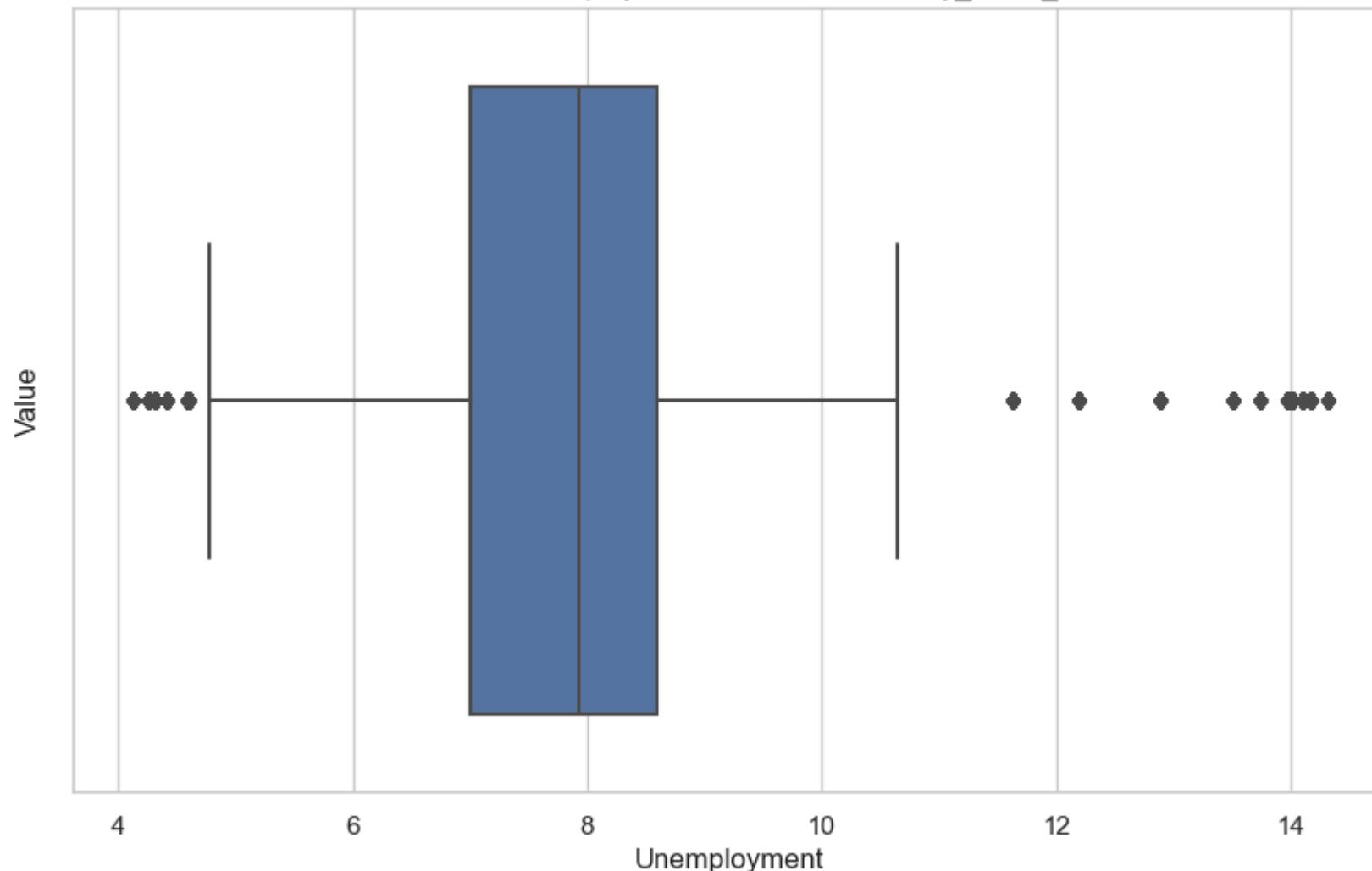


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_3w

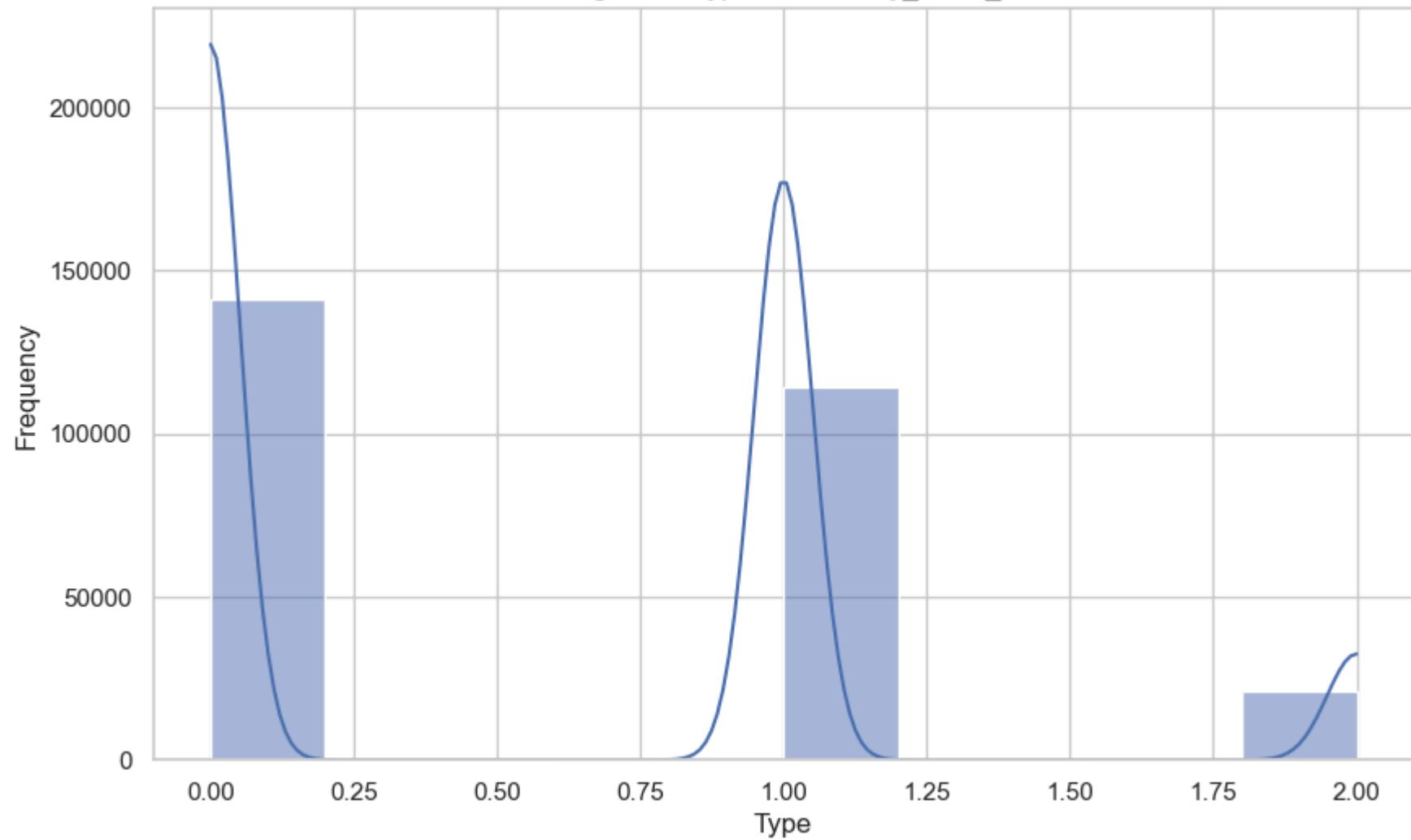


Box Plot of Unemployment in Data with Weekly_Sales_3w

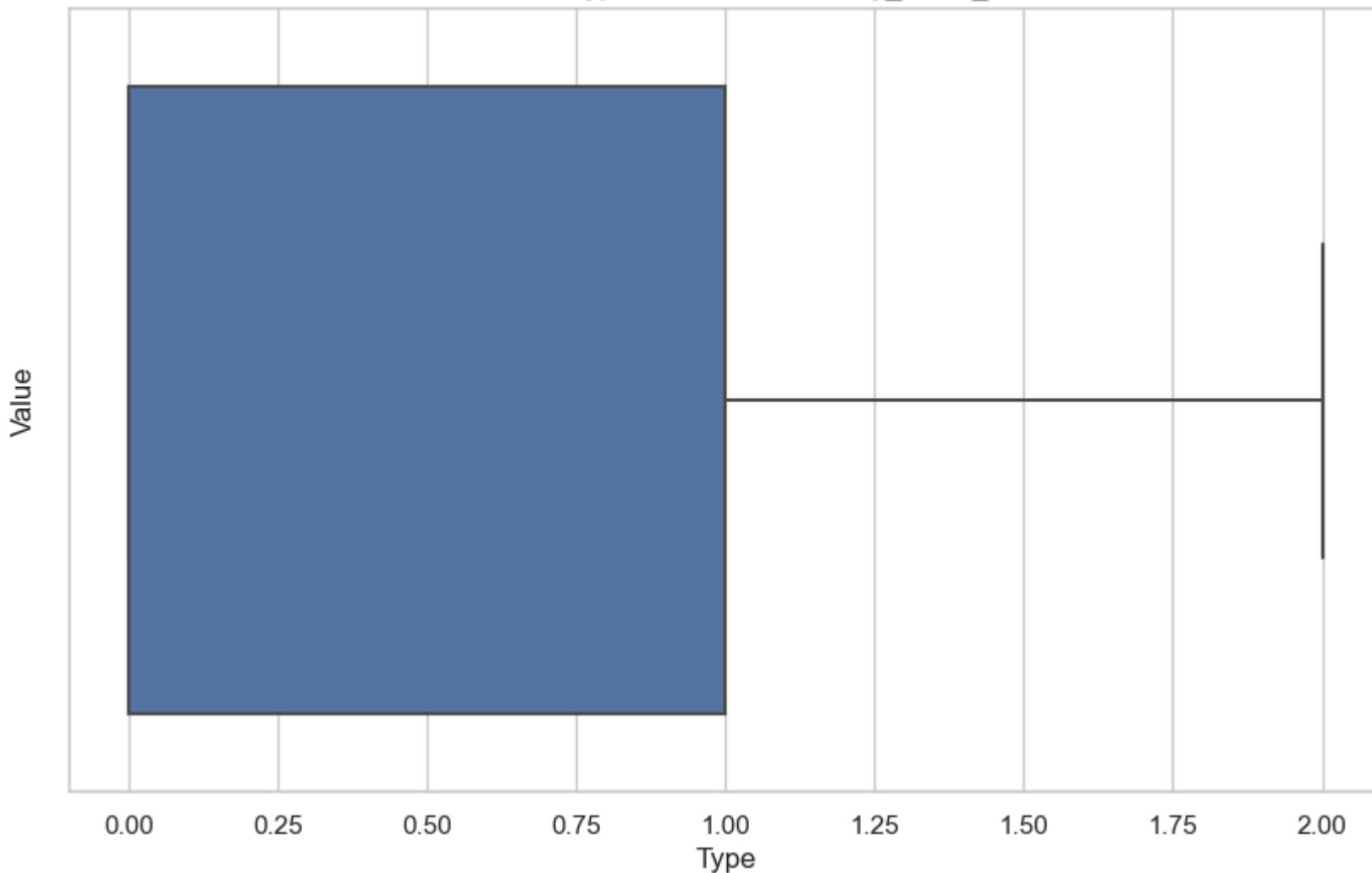


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_3w

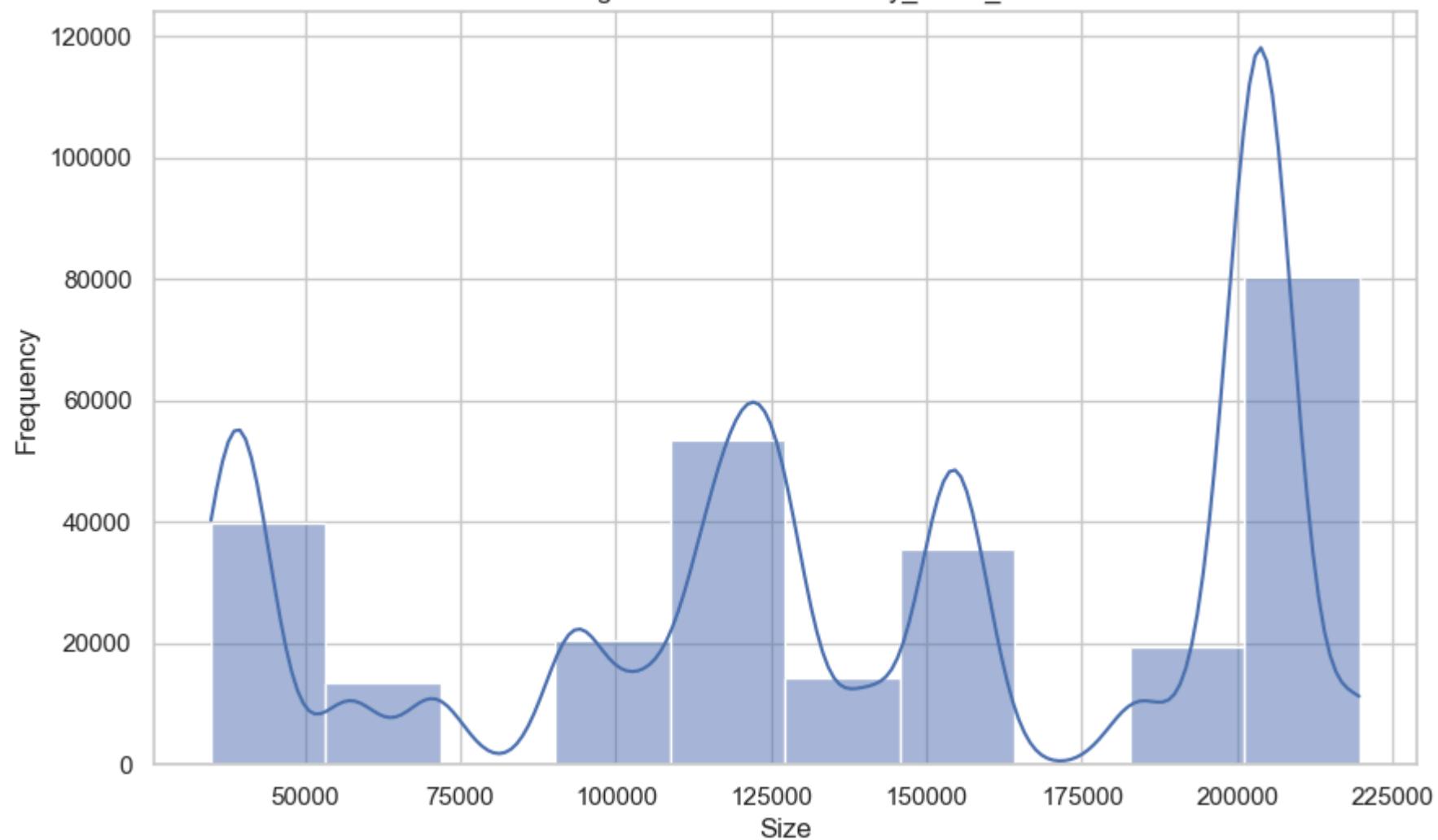


Box Plot of Type in Data with Weekly_Sales_3w

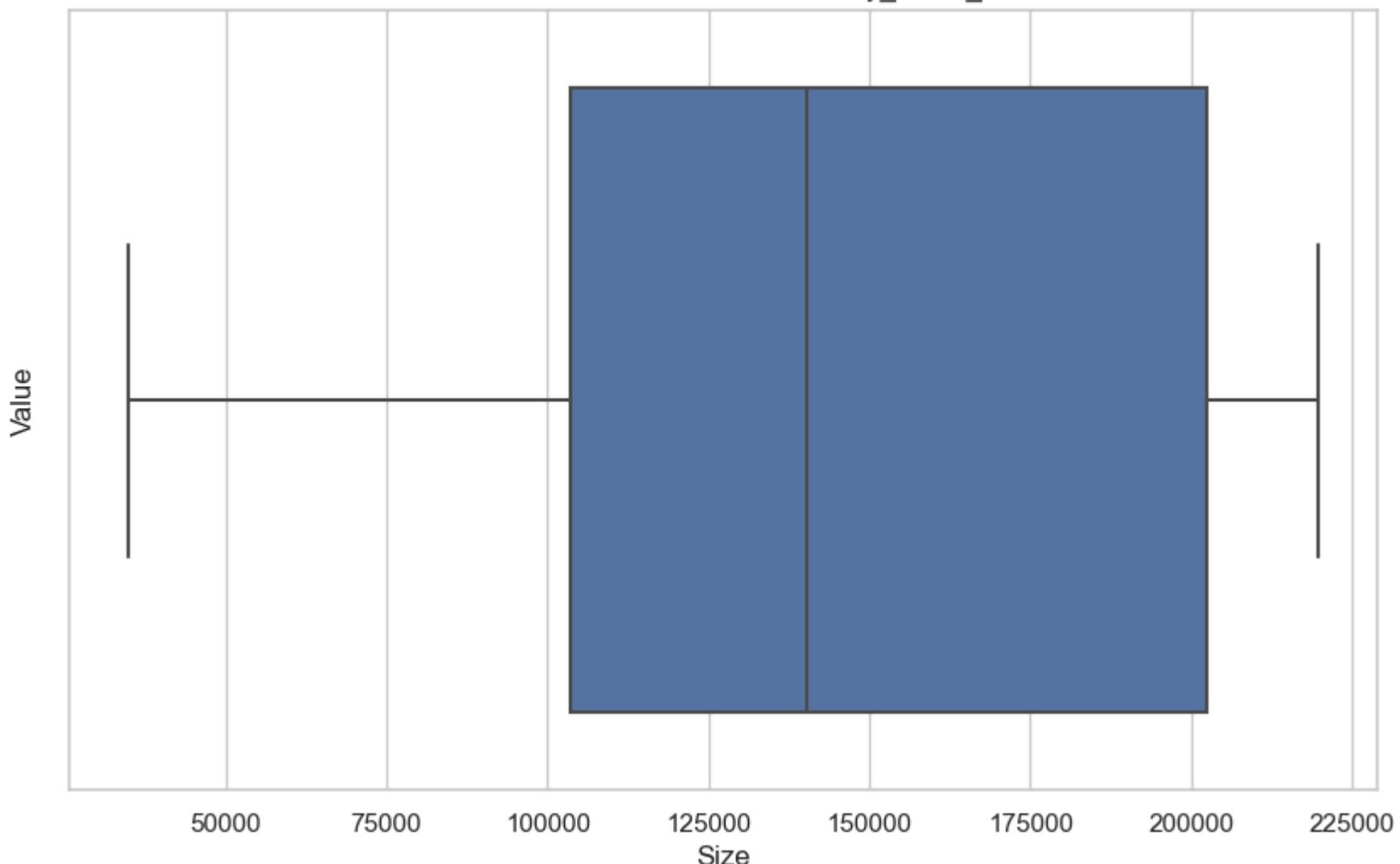


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_3w

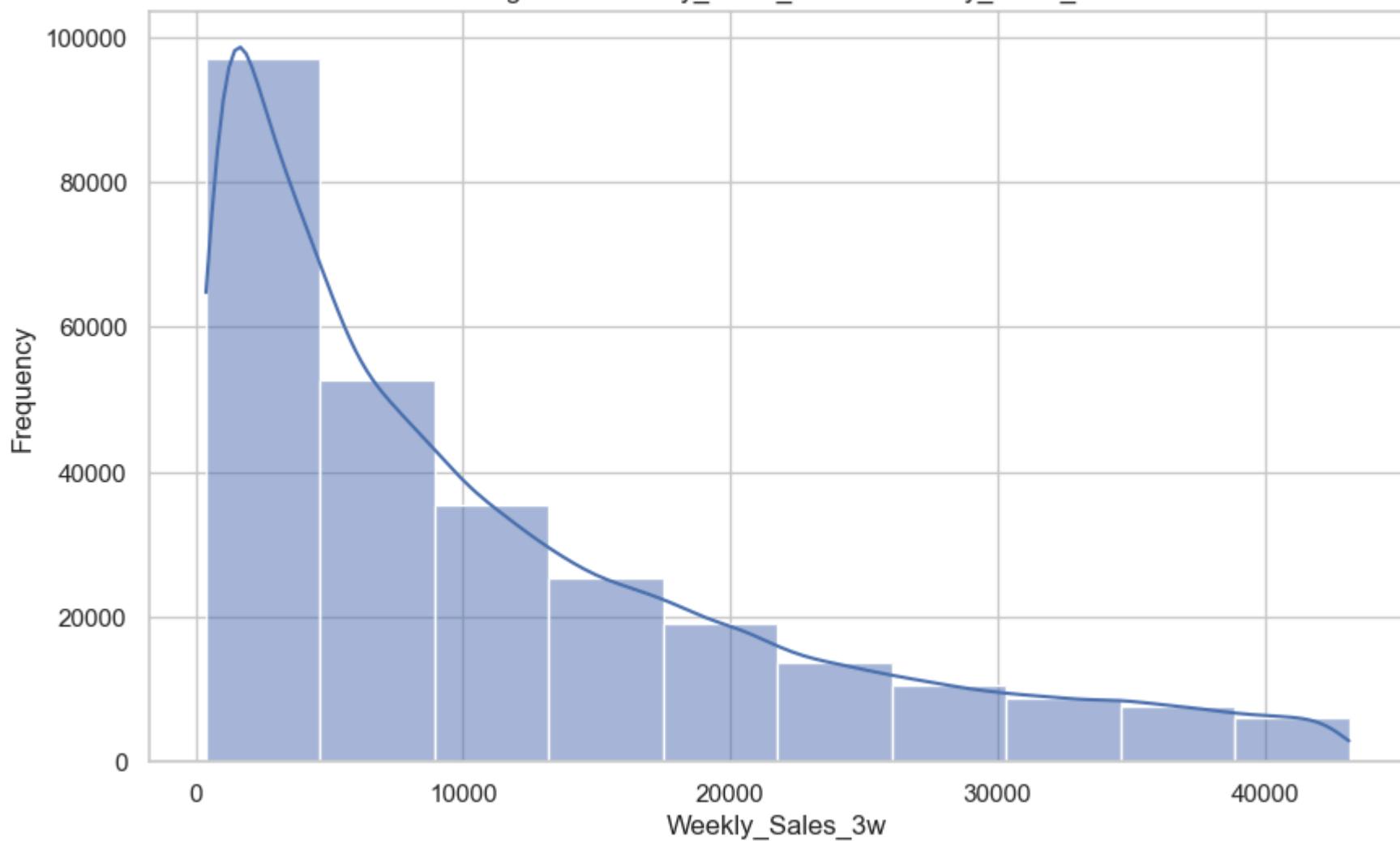


Box Plot of Size in Data with Weekly_Sales_3w

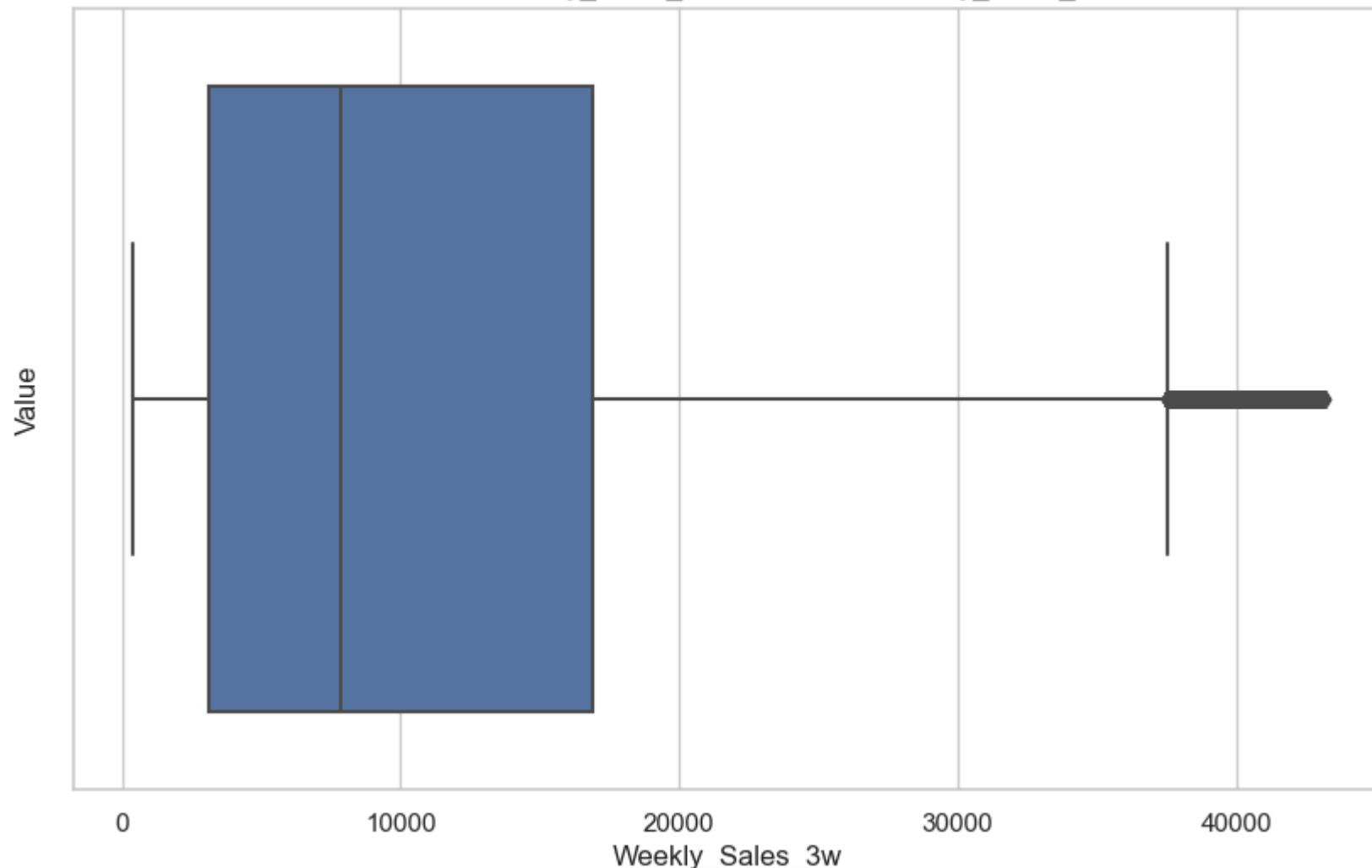


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_3w with Weekly_Sales_3w

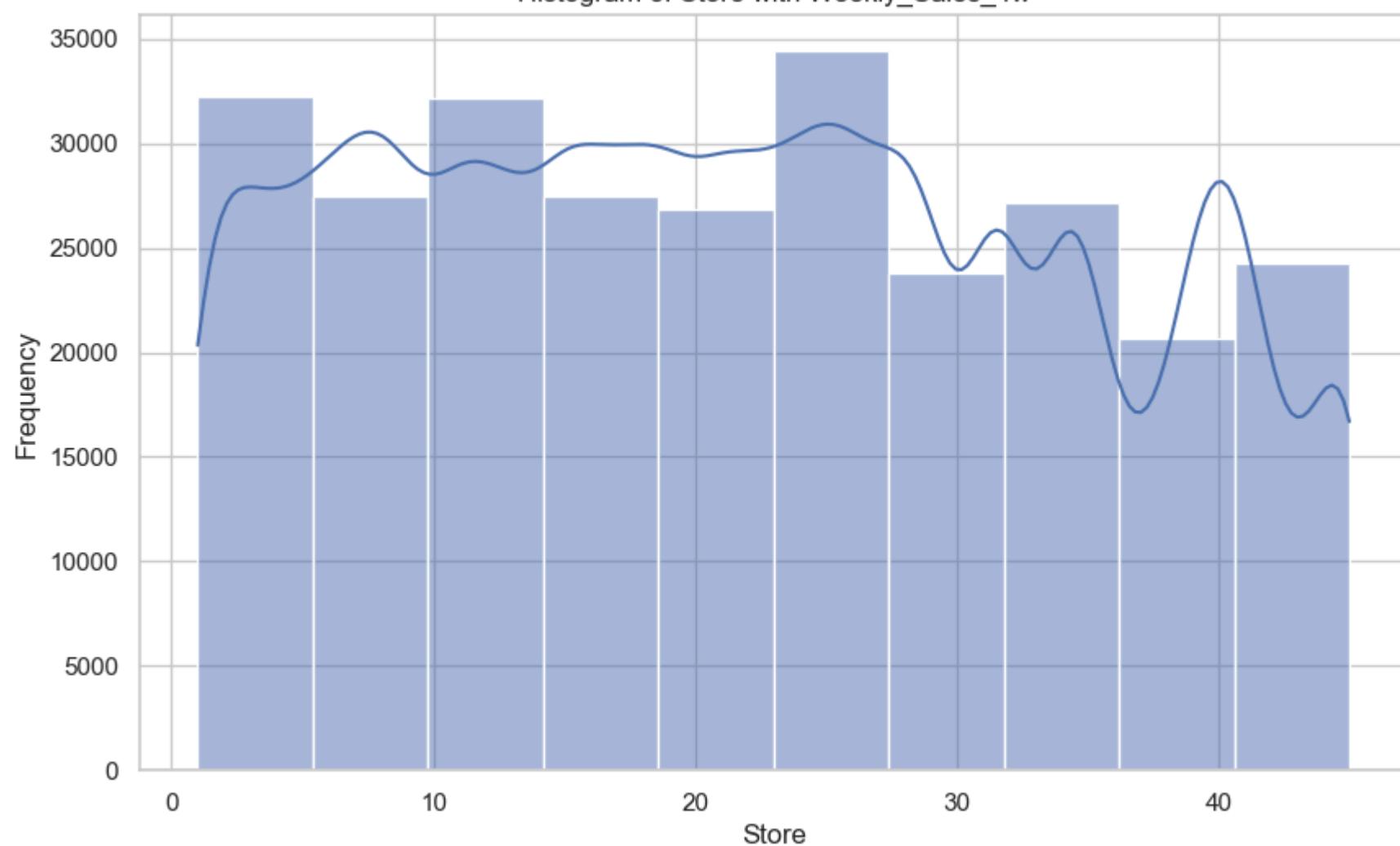


Box Plot of Weekly_Sales_3w in Data with Weekly_Sales_3w

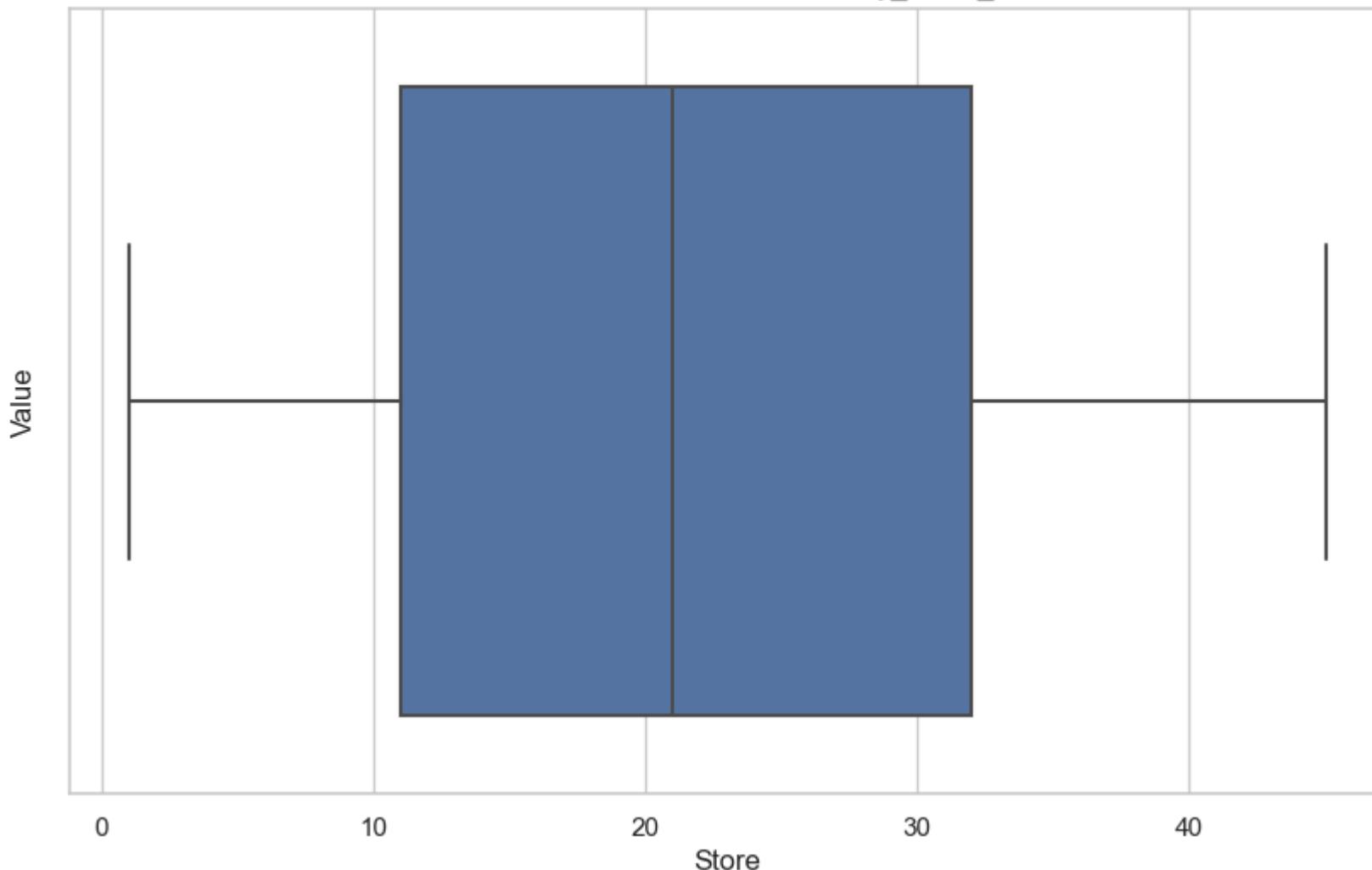


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_4w

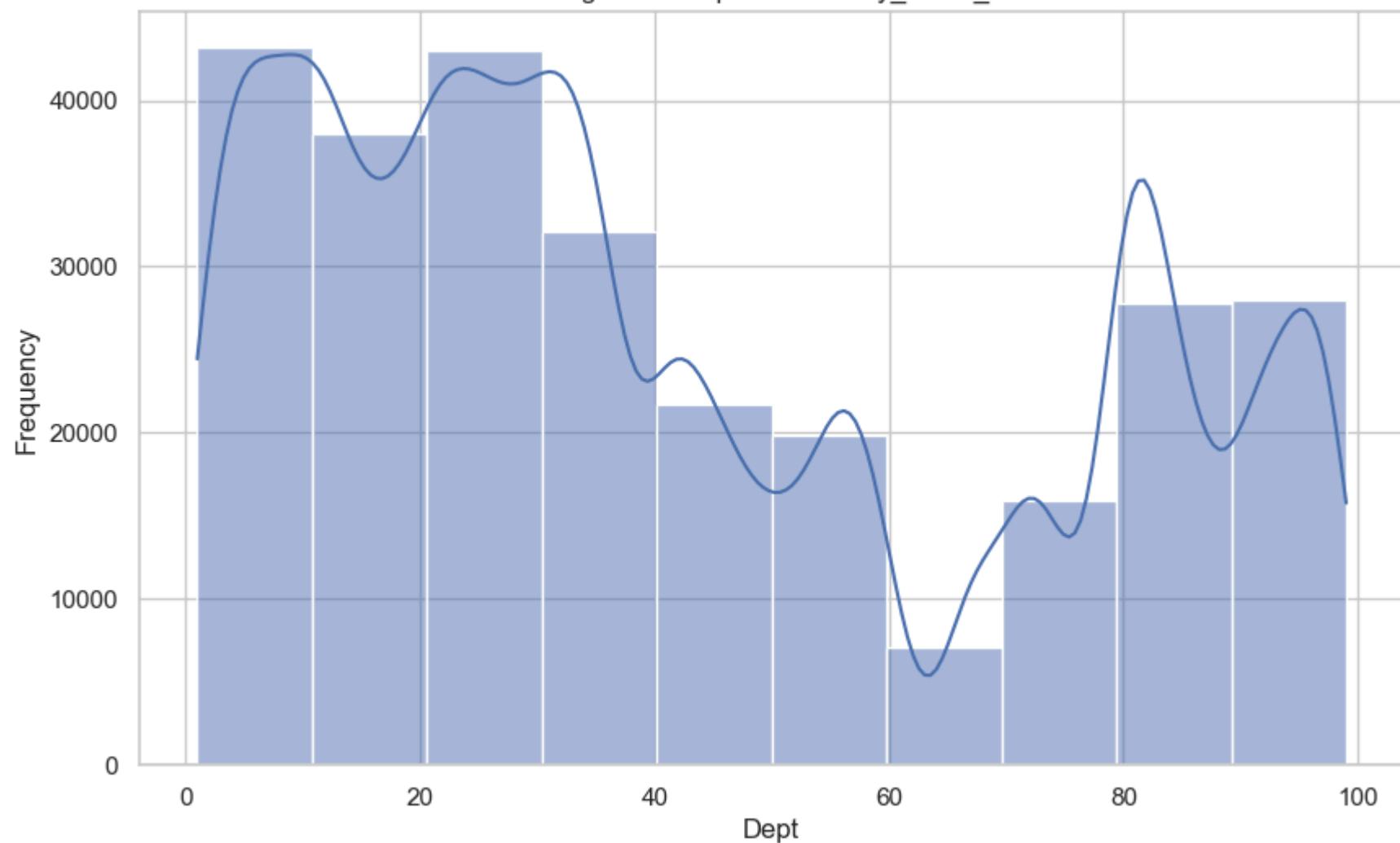


Box Plot of Store in Data with Weekly_Sales_4w

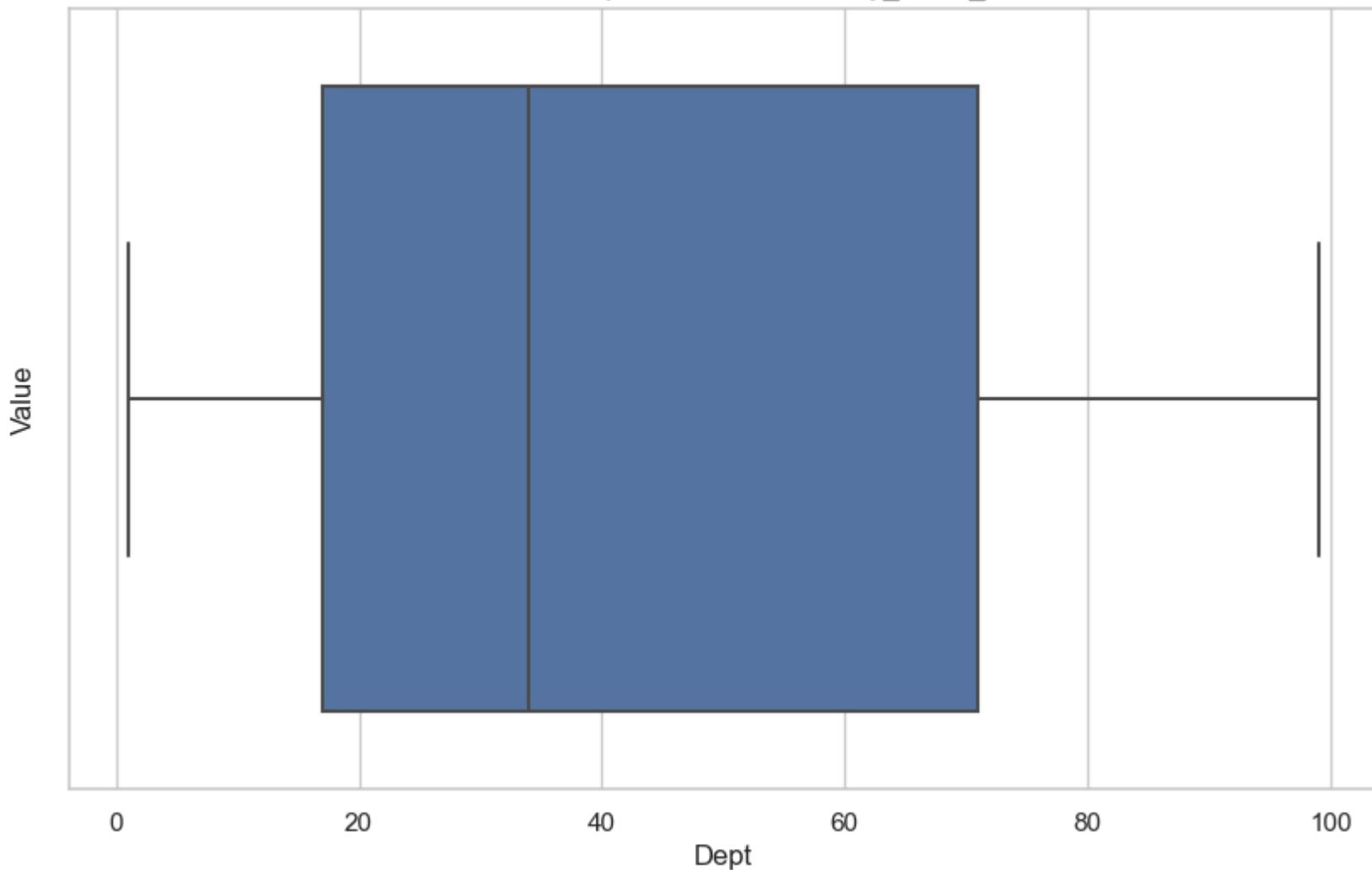


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_4w

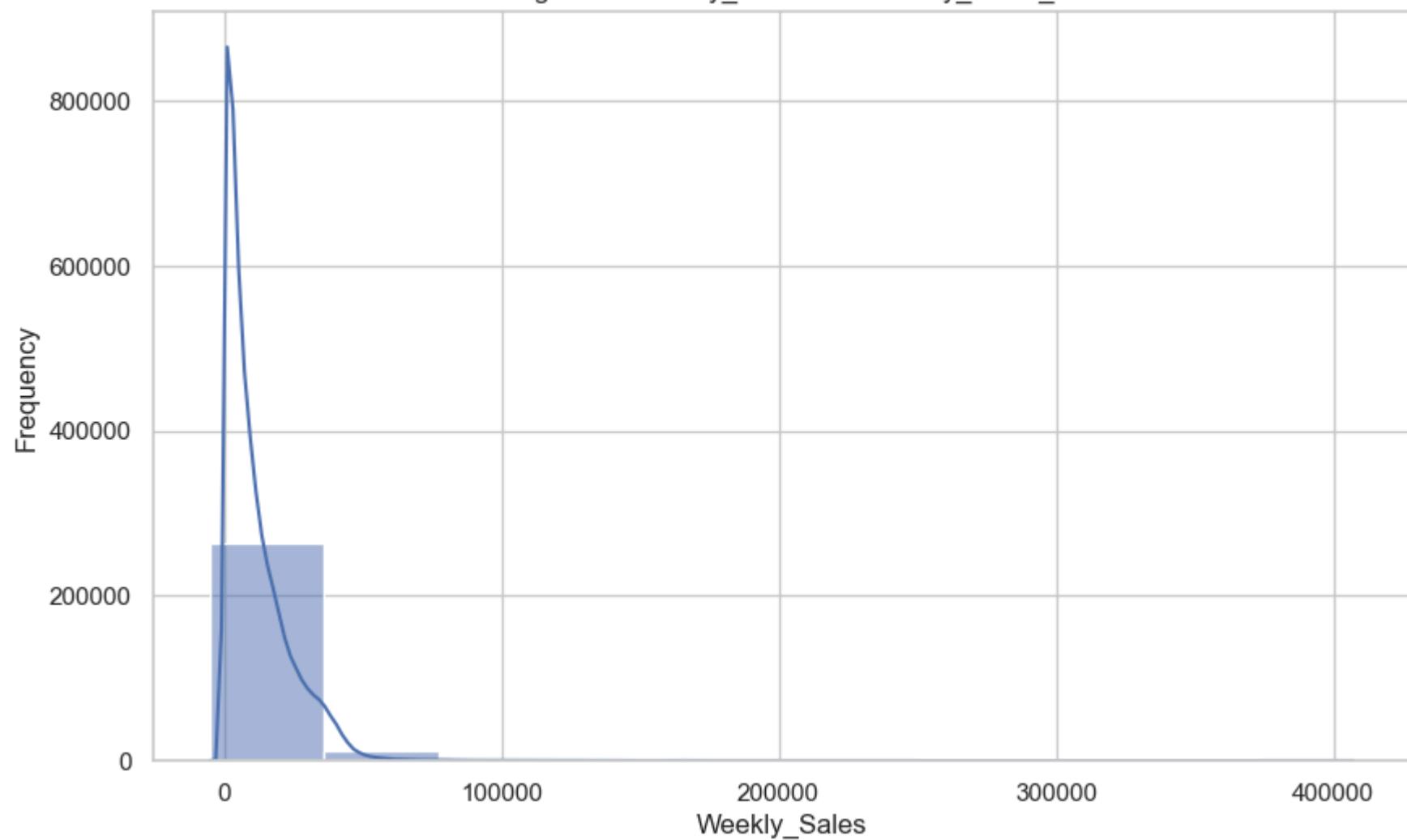


Box Plot of Dept in Data with Weekly_Sales_4w

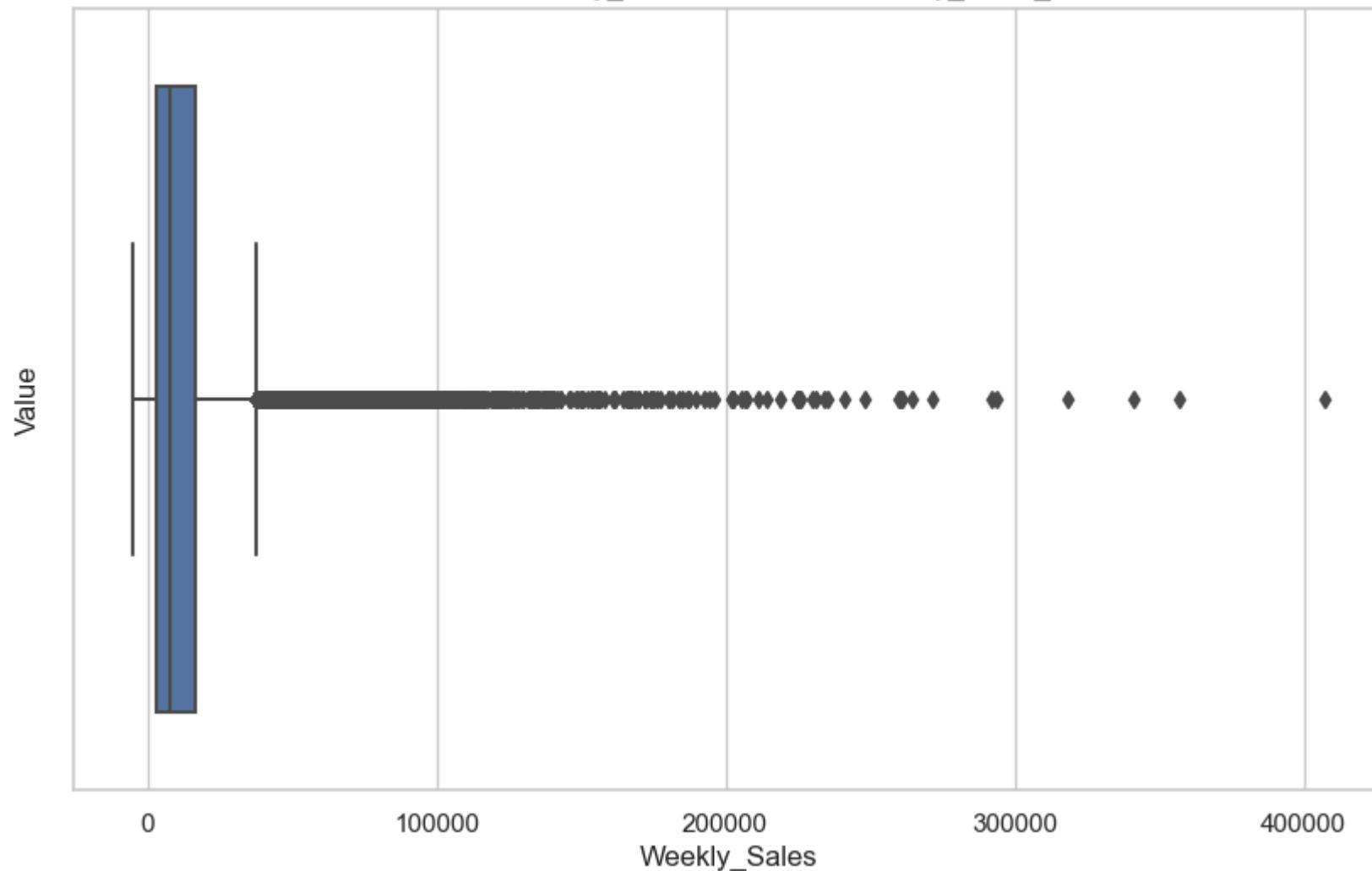


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_4w

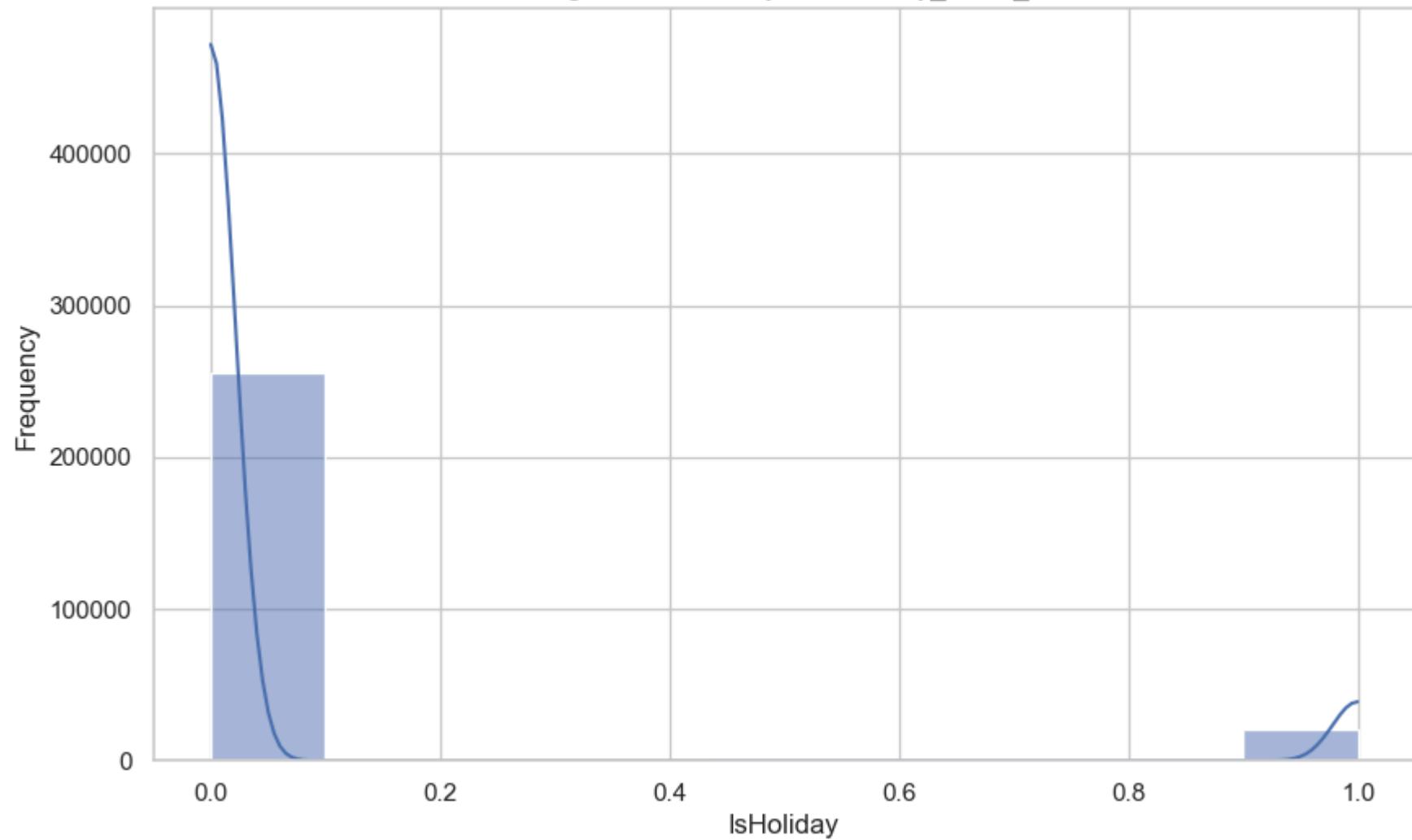


Box Plot of Weekly_Sales in Data with Weekly_Sales_4w

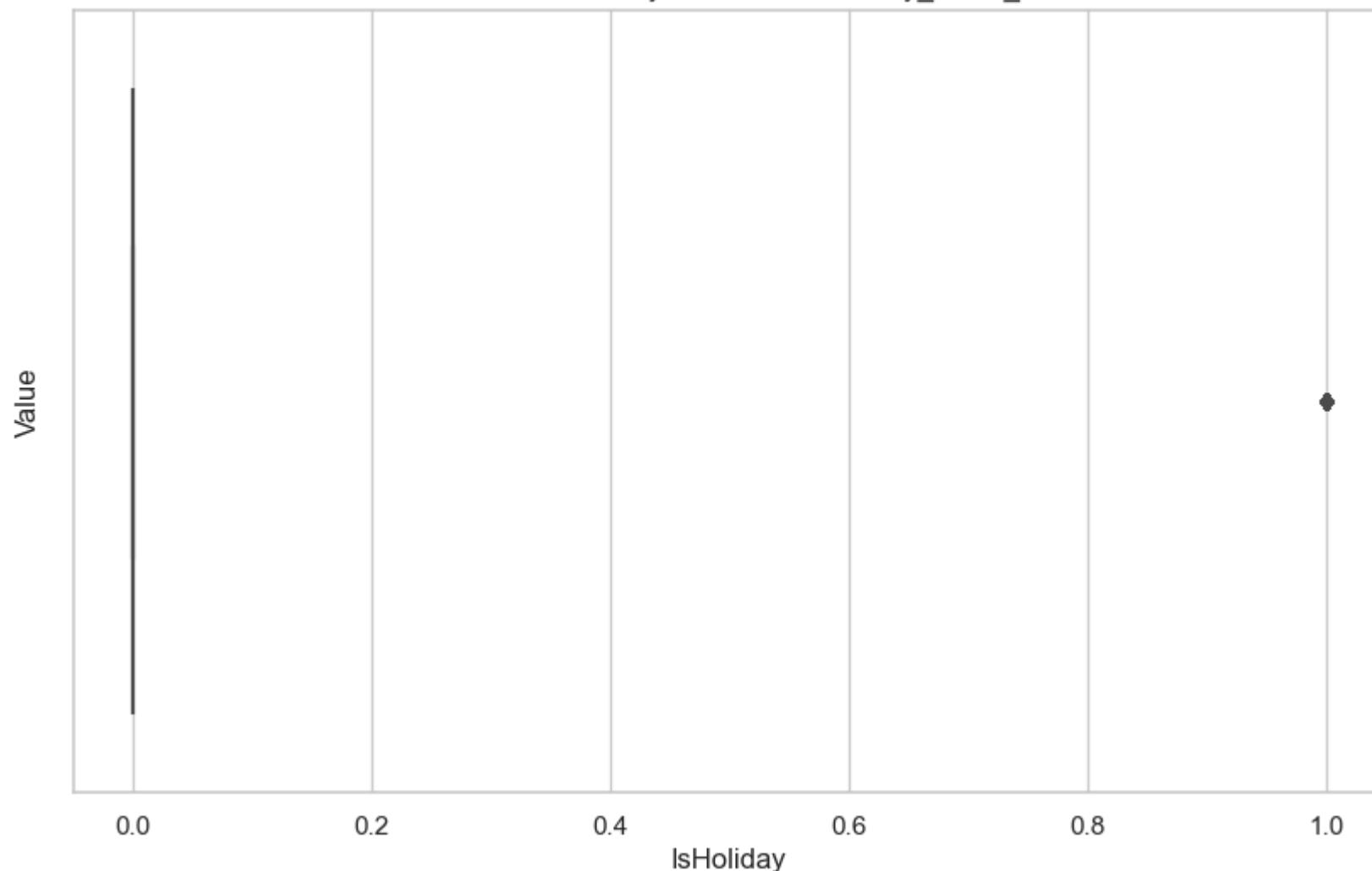


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_4w

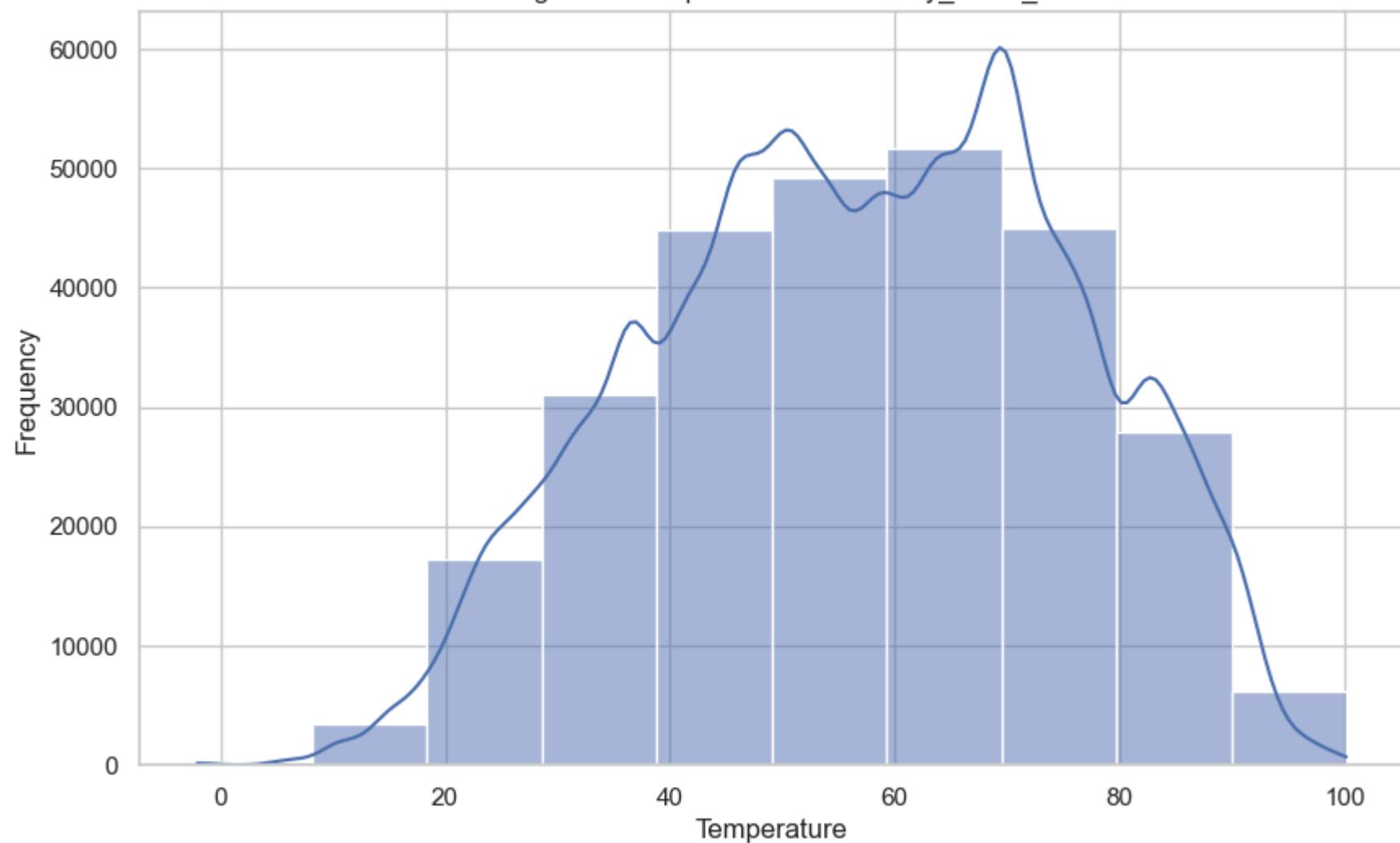


Box Plot of IsHoliday in Data with Weekly_Sales_4w

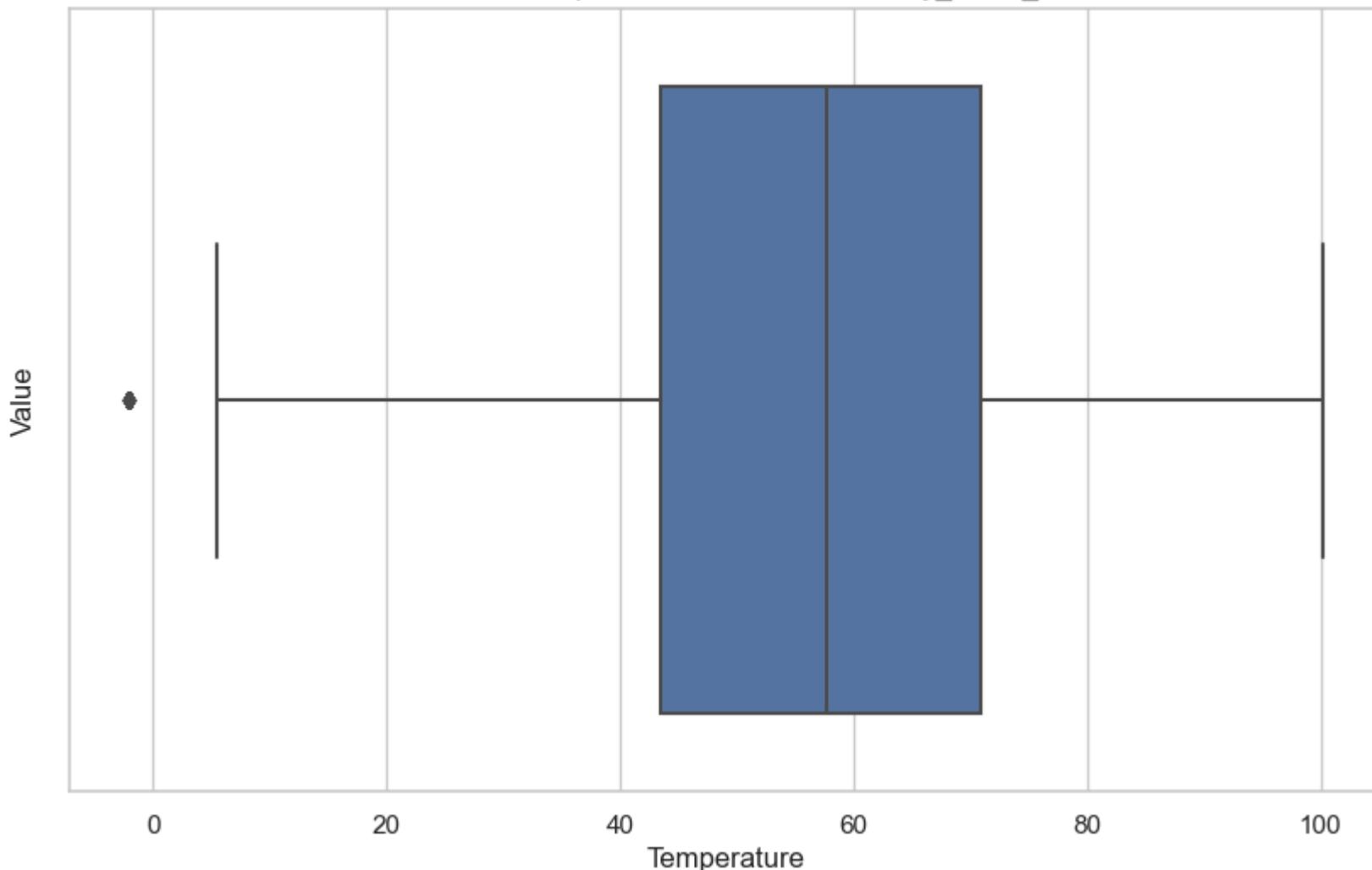


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_4w

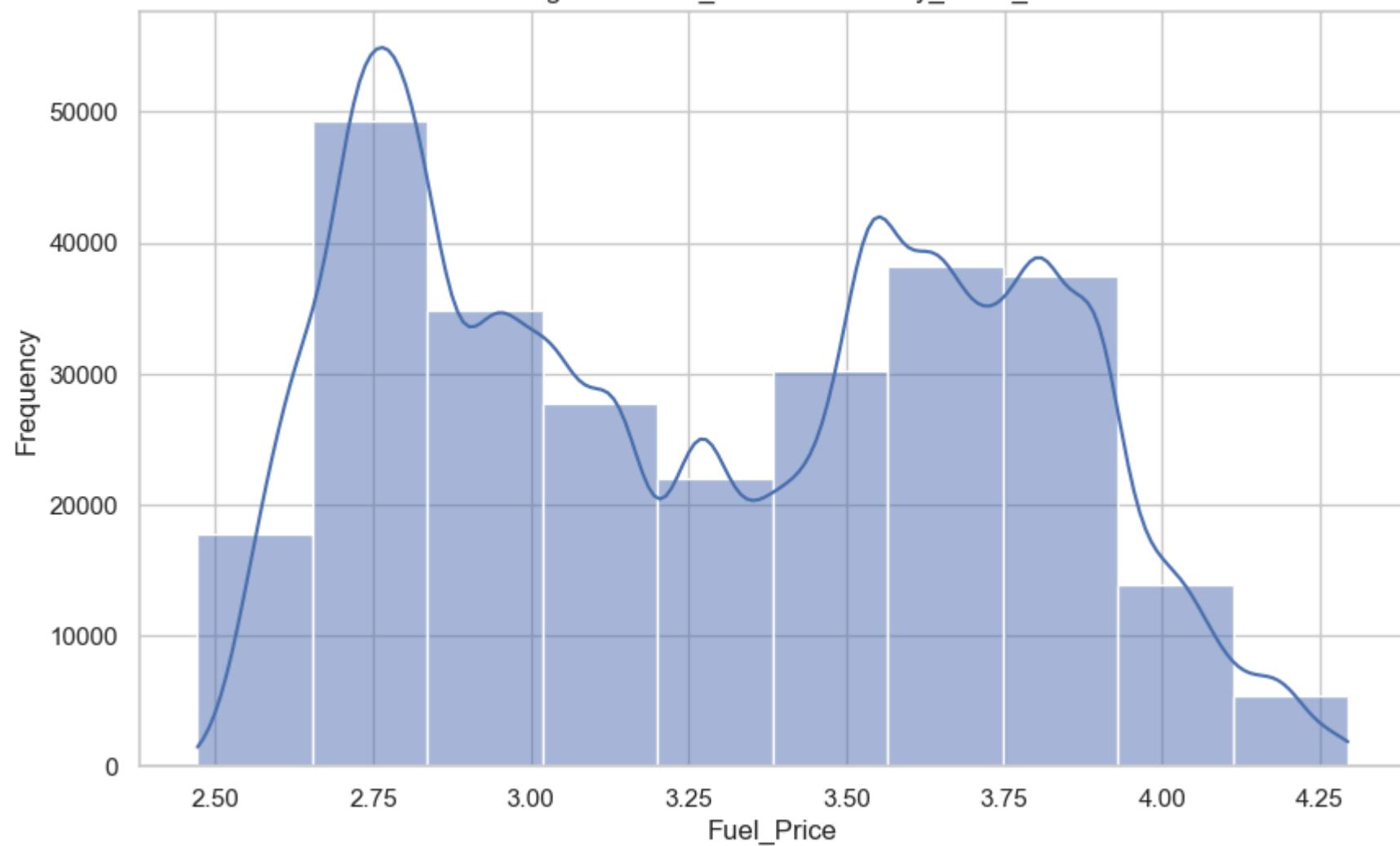


Box Plot of Temperature in Data with Weekly_Sales_4w

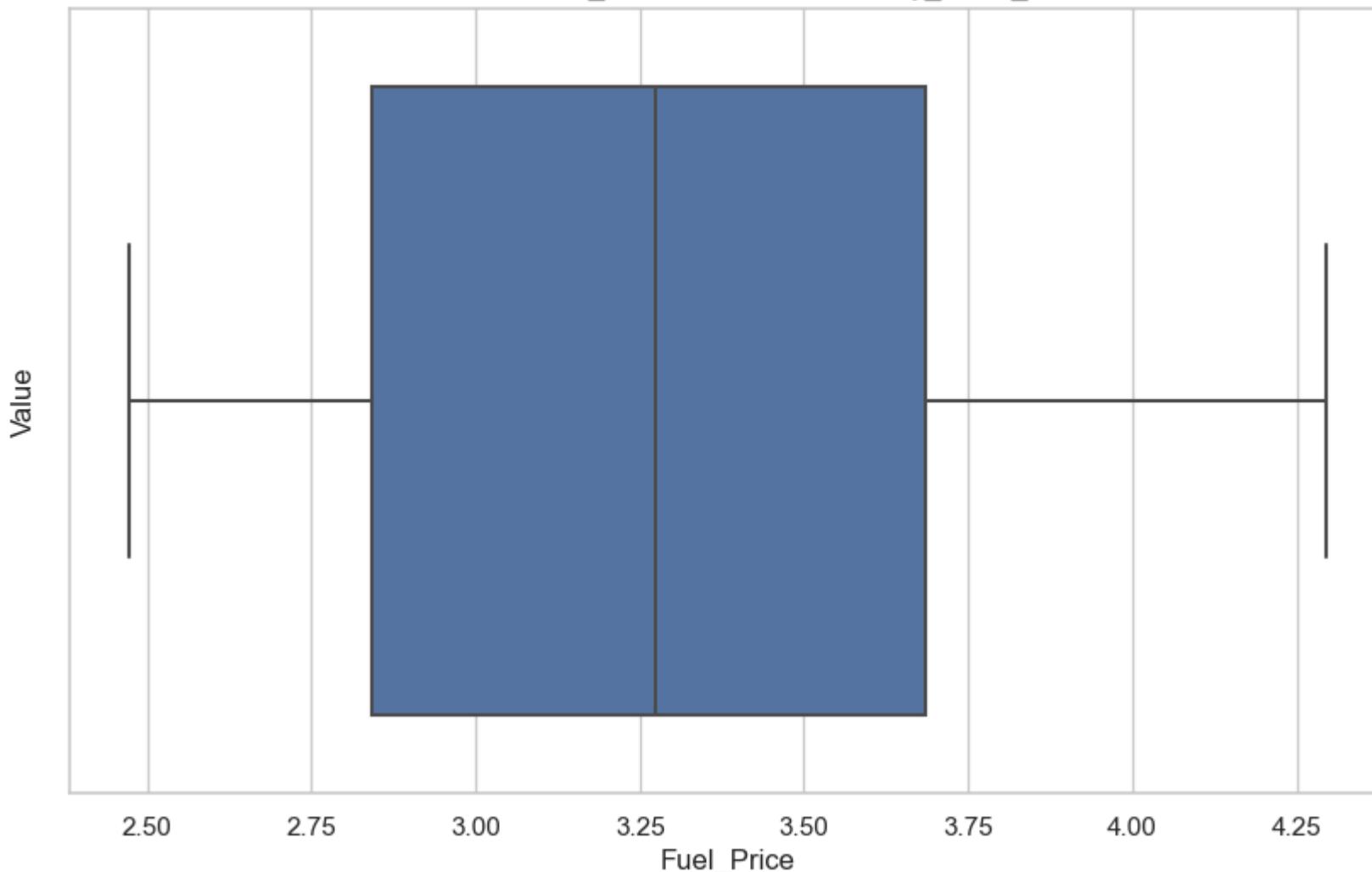


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

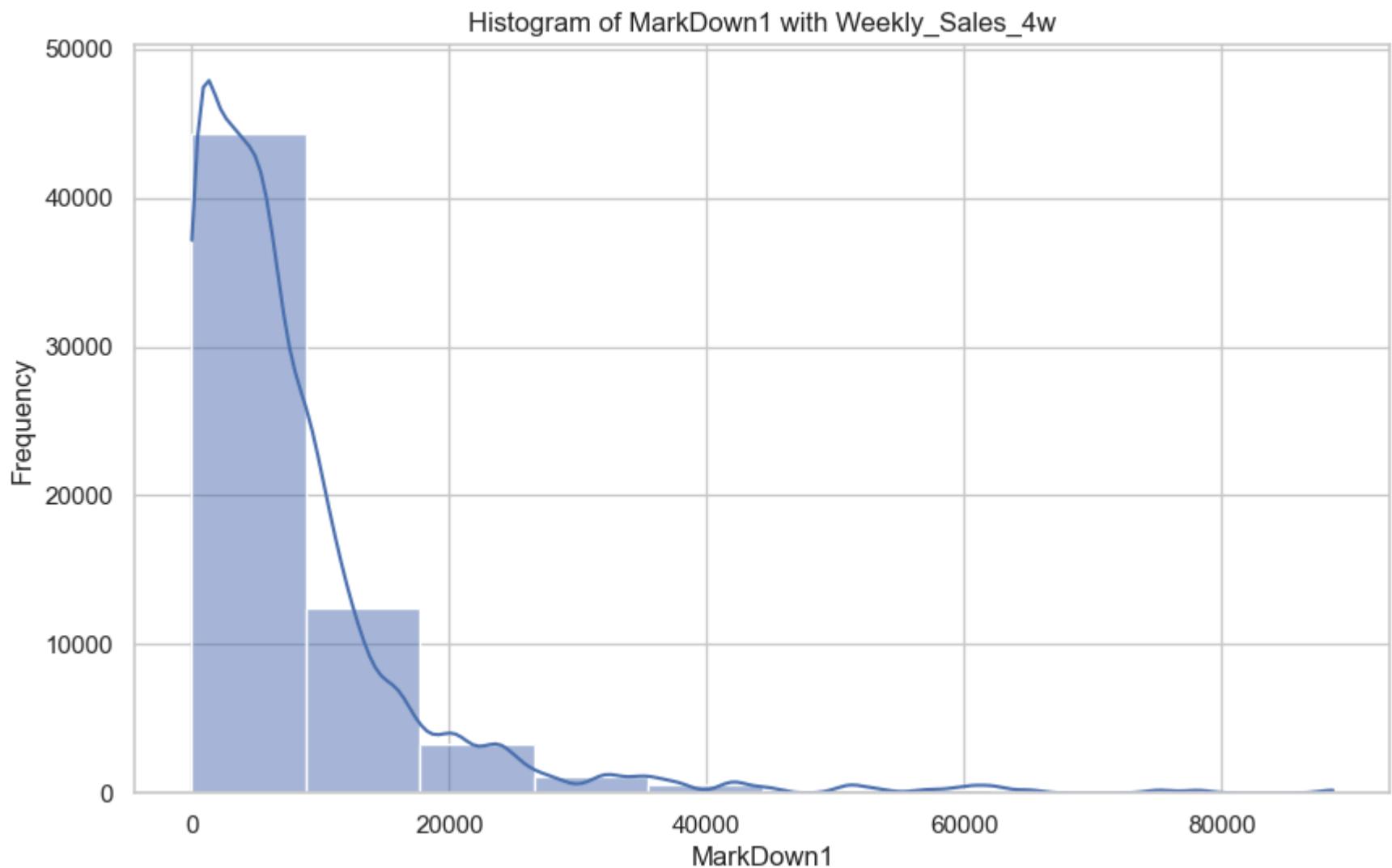
Histogram of Fuel_Price with Weekly_Sales_4w



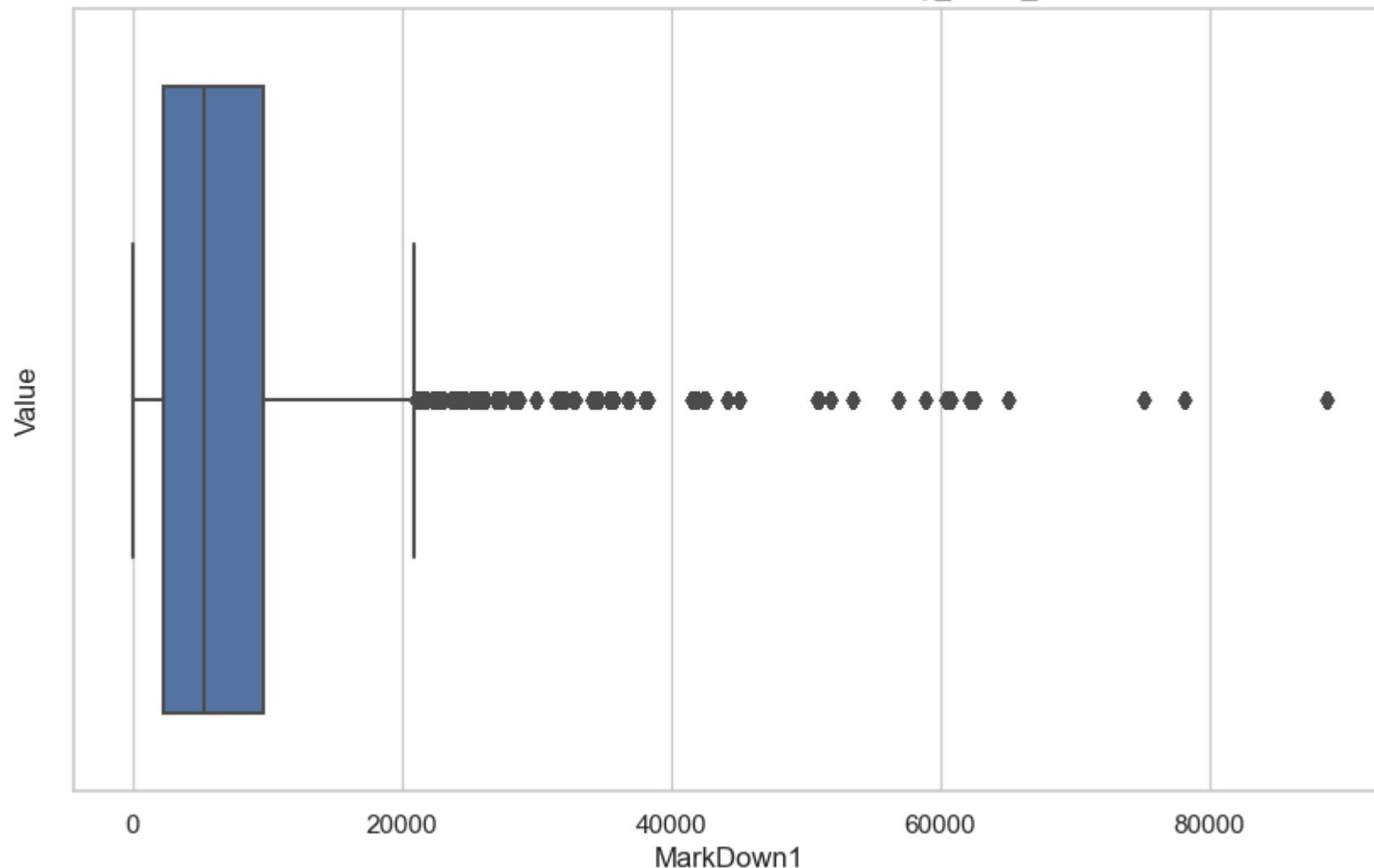
Box Plot of Fuel_Price in Data with Weekly_Sales_4w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

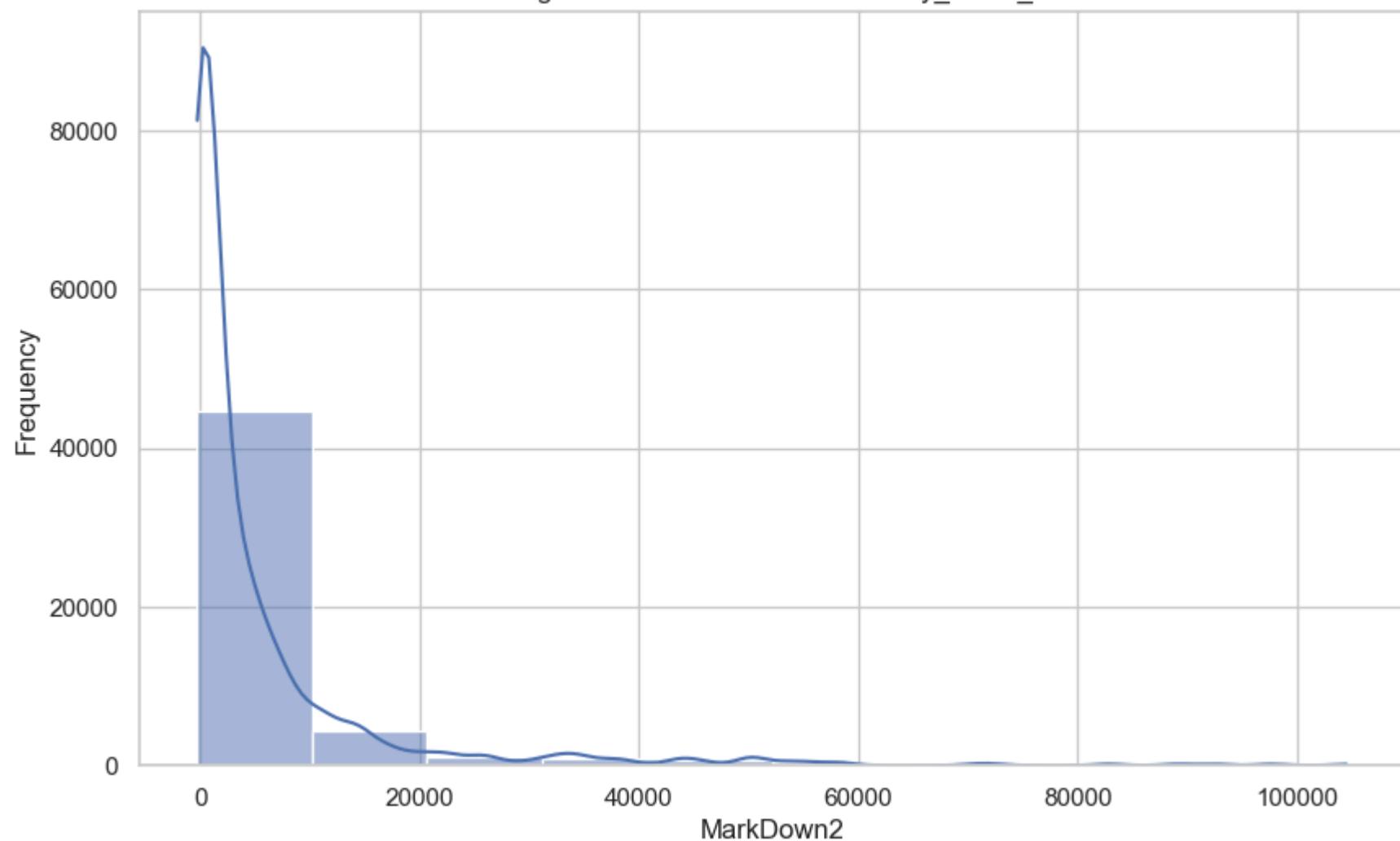


Box Plot of MarkDown1 in Data with Weekly_Sales_4w

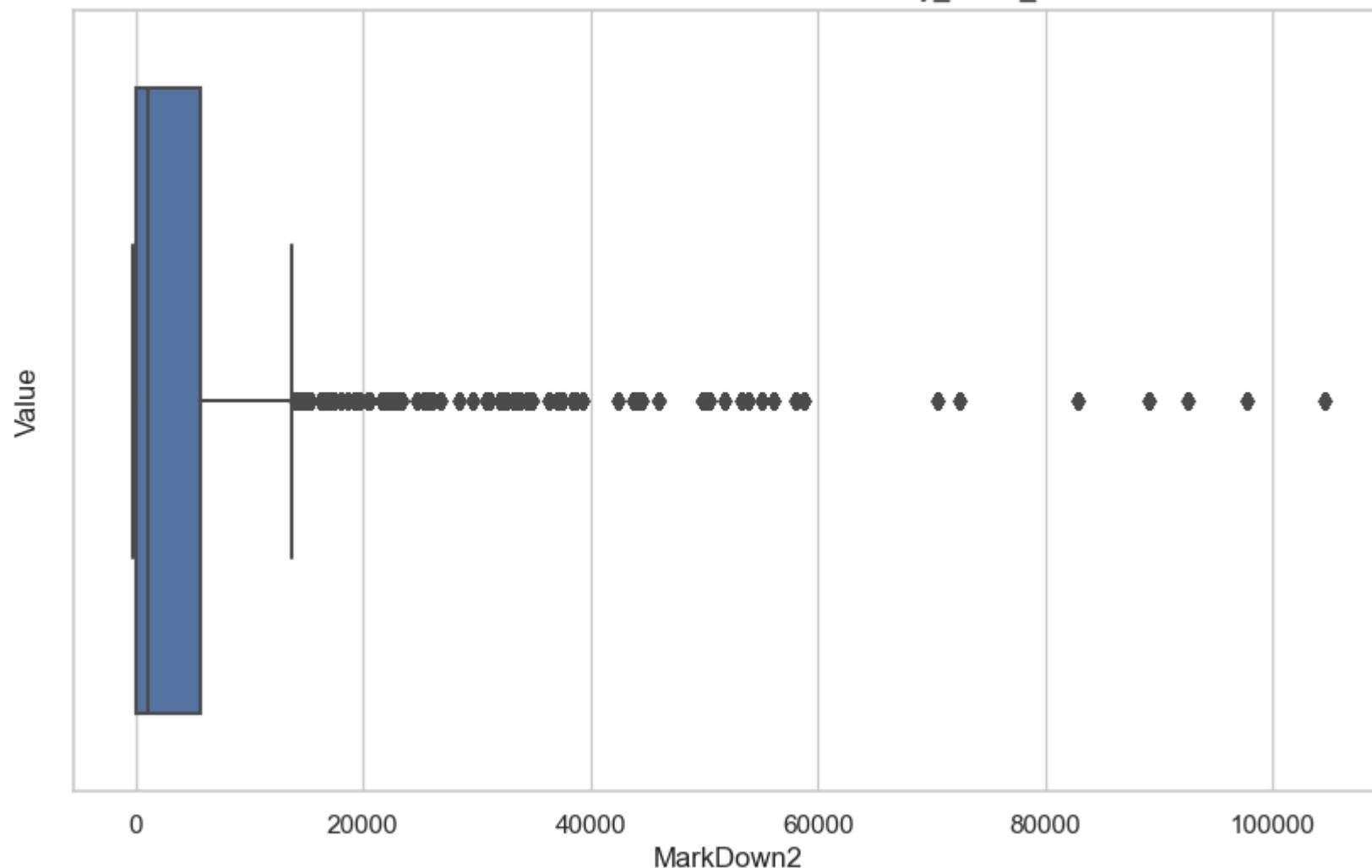


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_4w

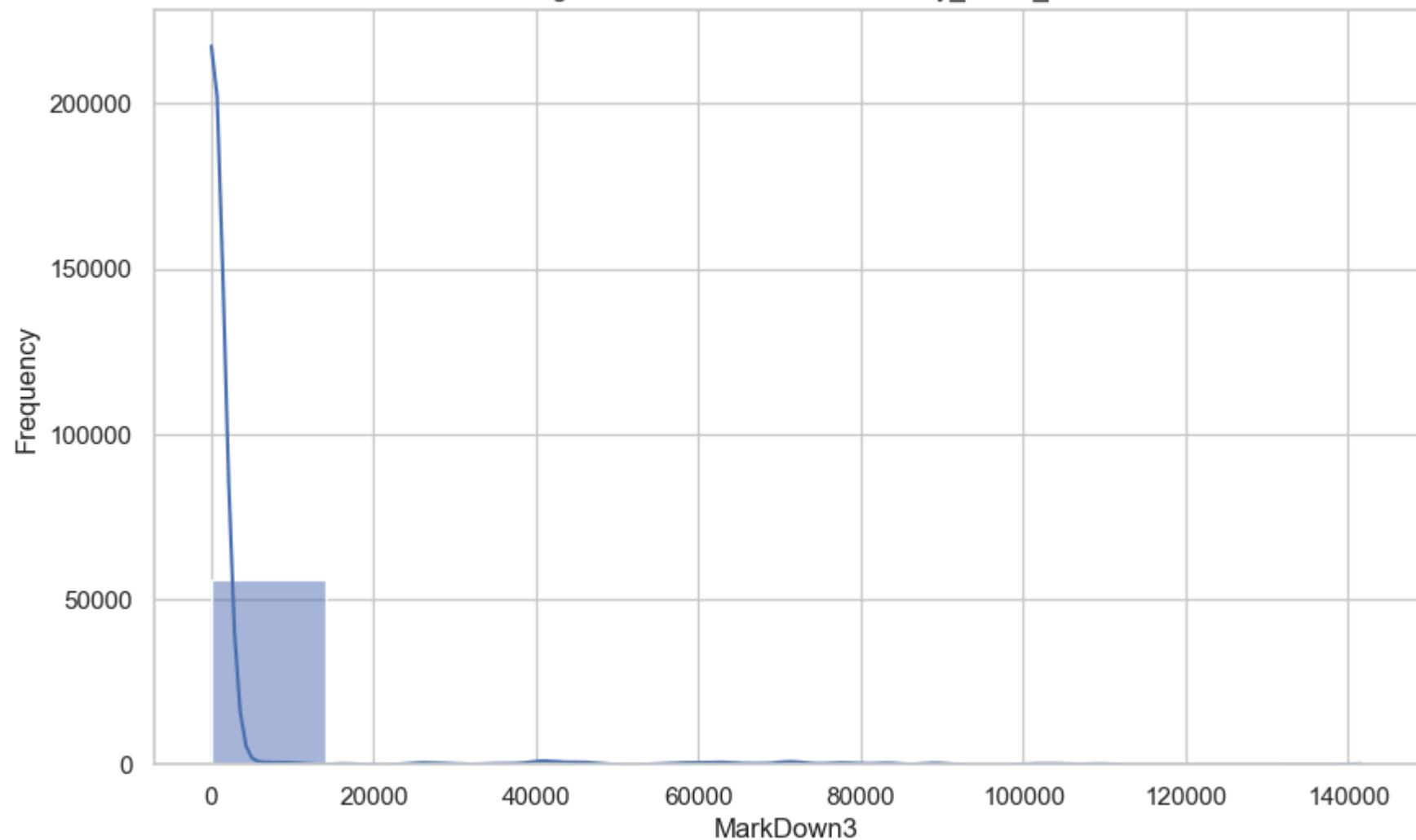


Box Plot of MarkDown2 in Data with Weekly_Sales_4w

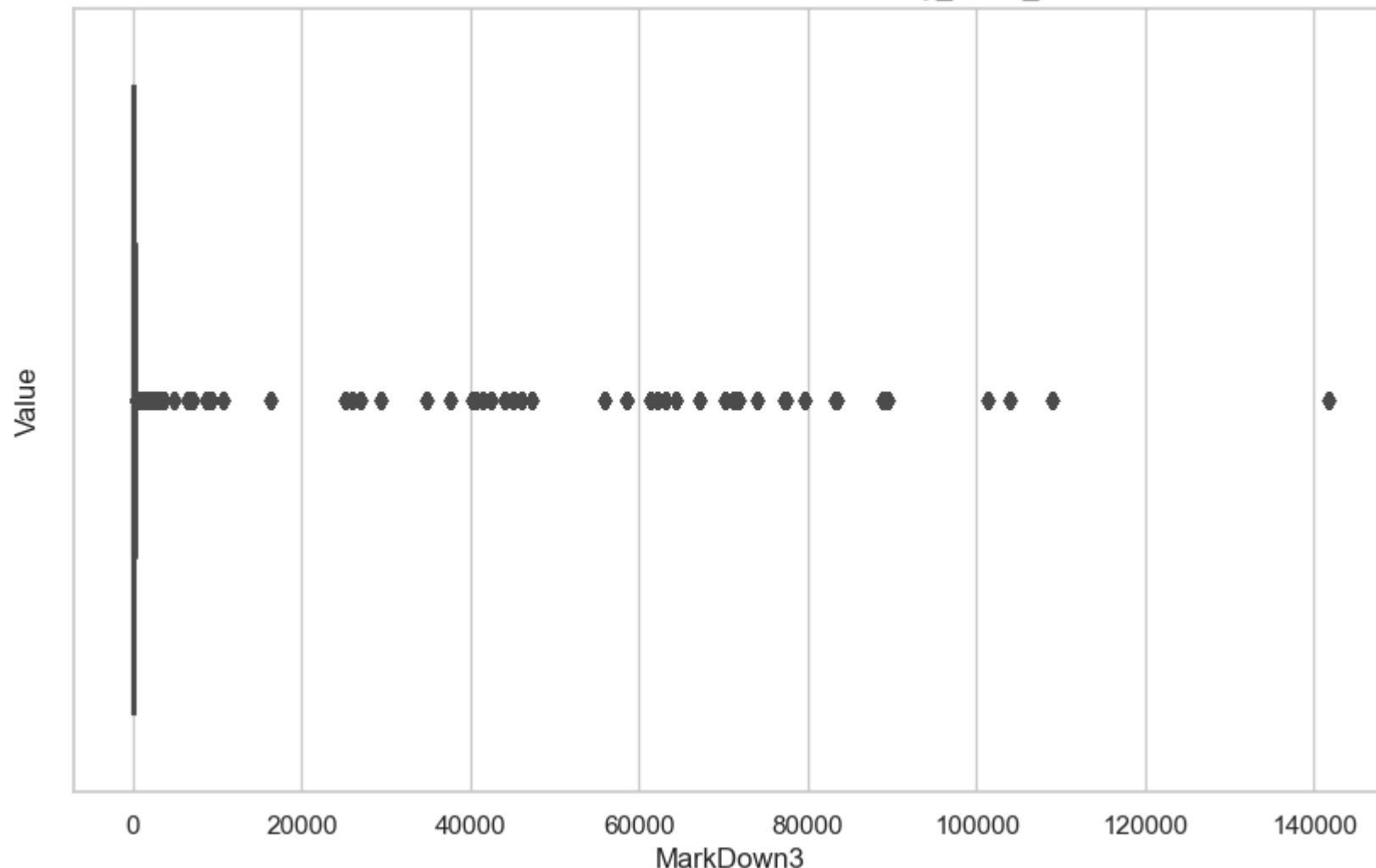


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_4w

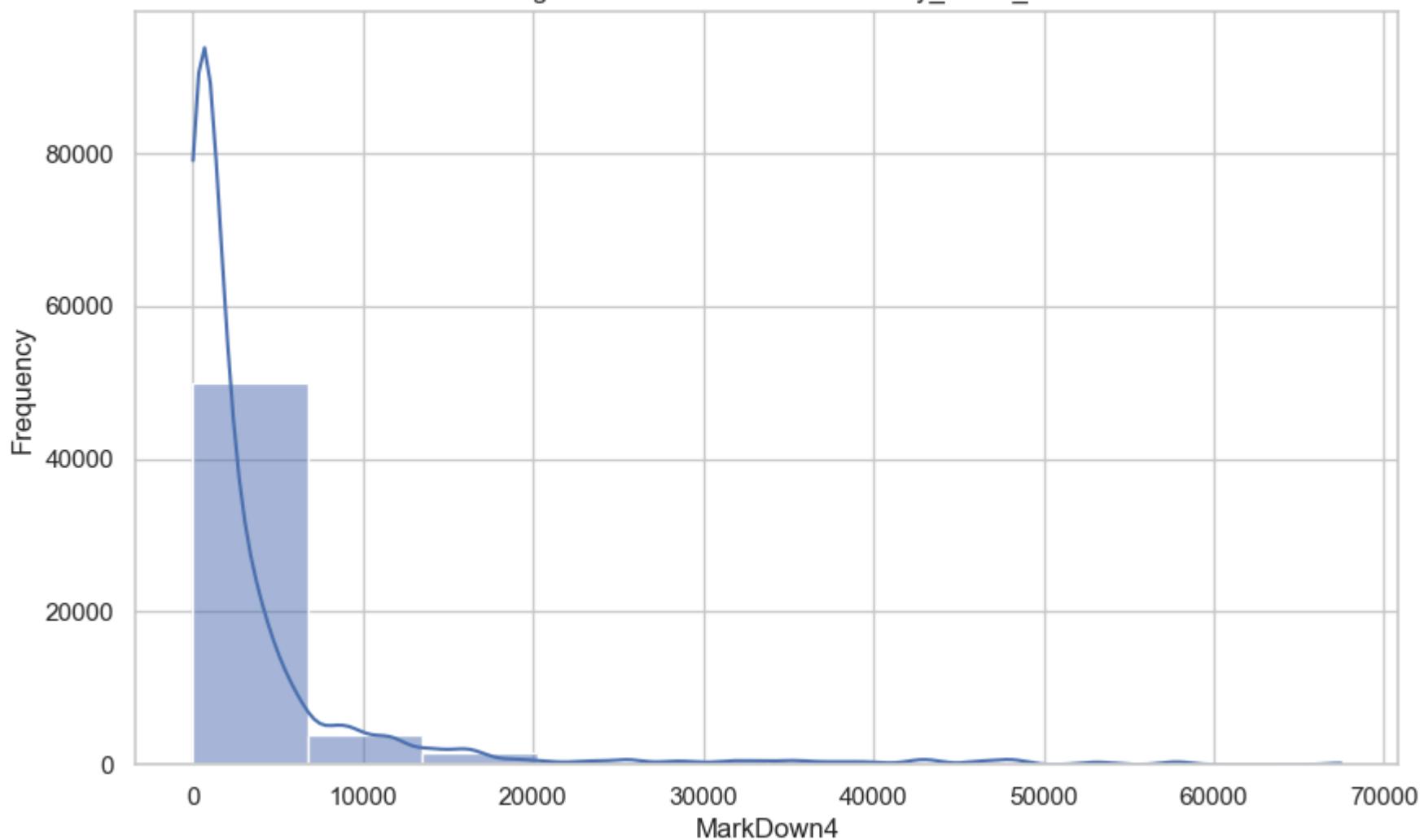


Box Plot of MarkDown3 in Data with Weekly_Sales_4w

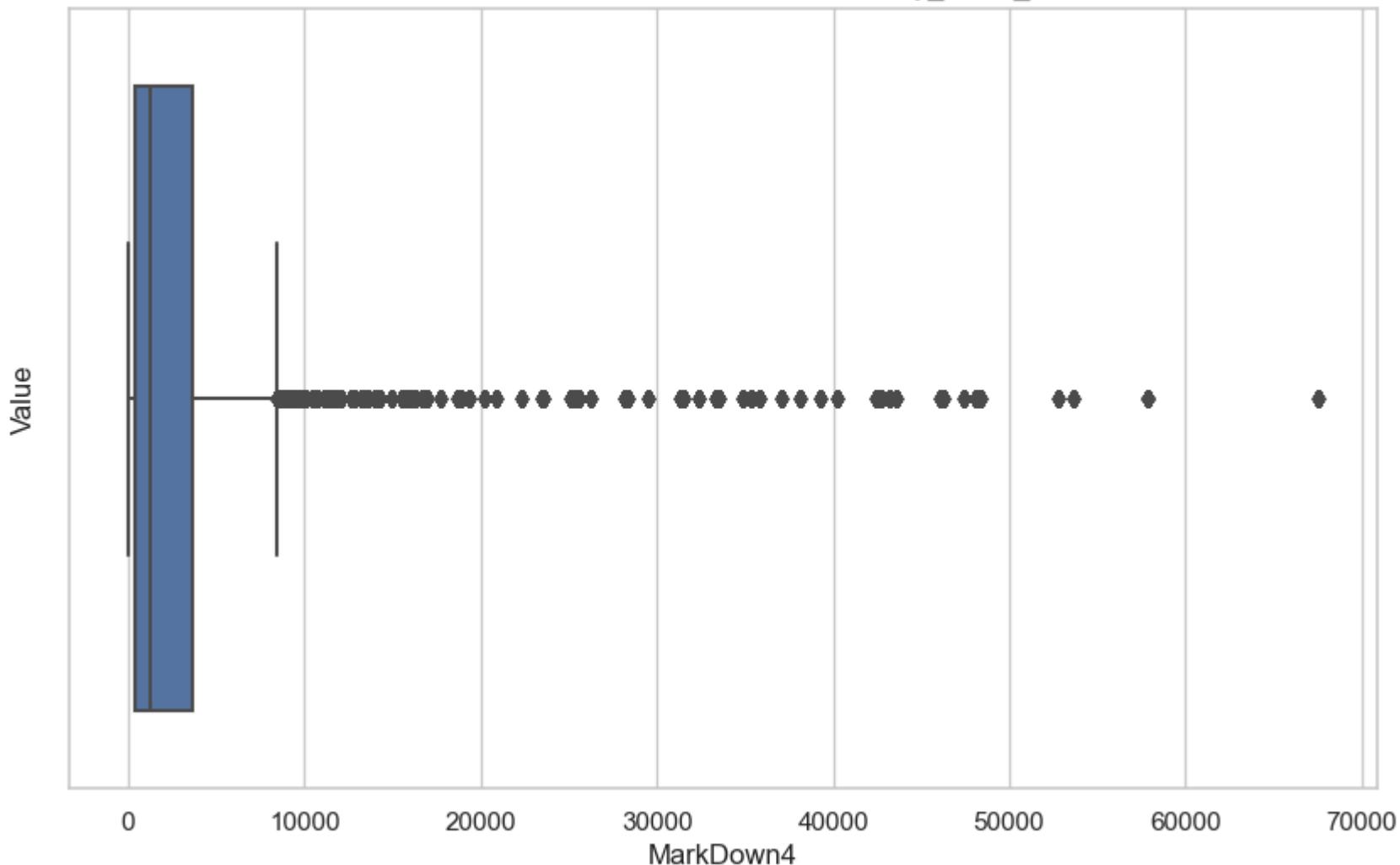


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_4w

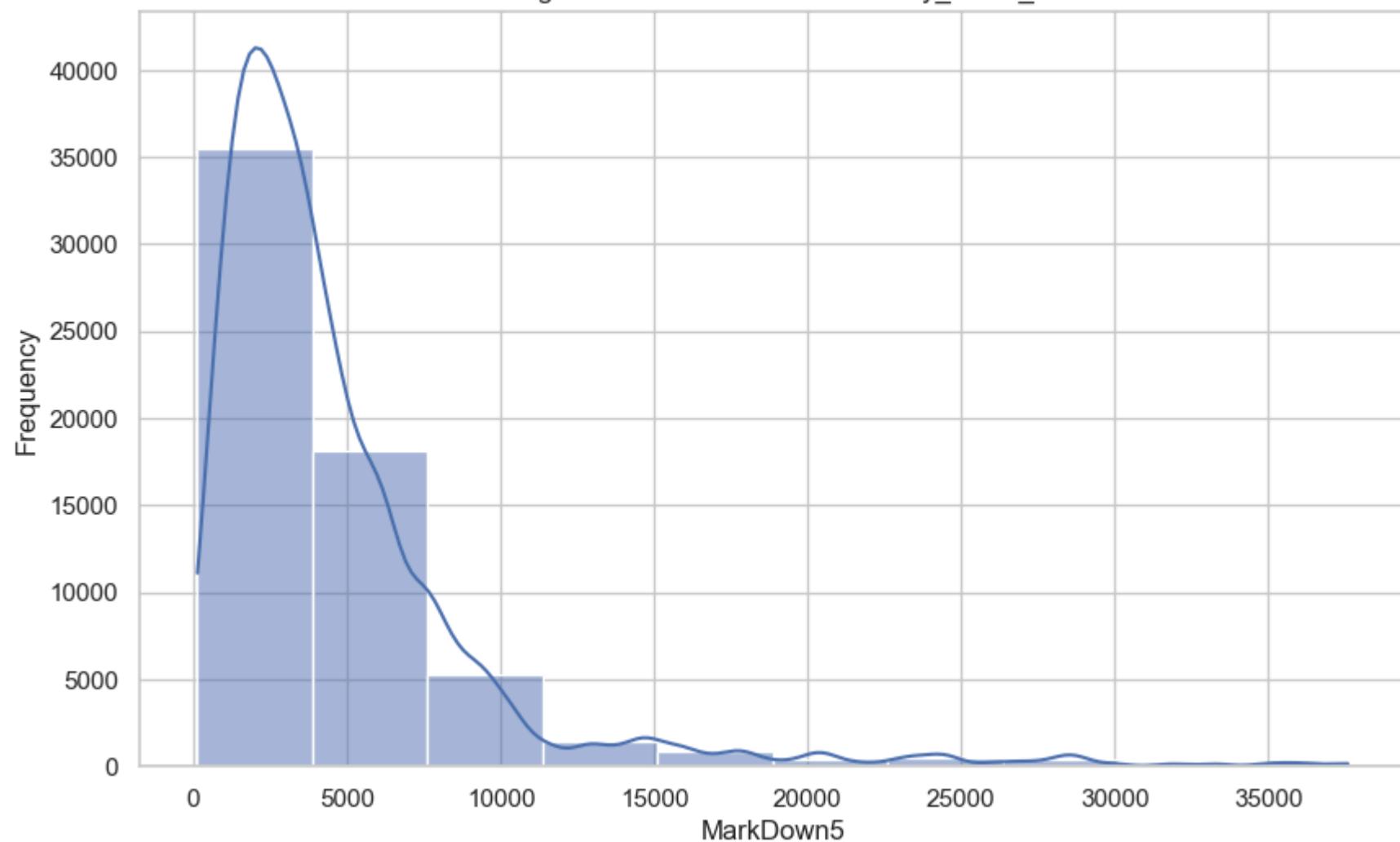


Box Plot of MarkDown4 in Data with Weekly_Sales_4w

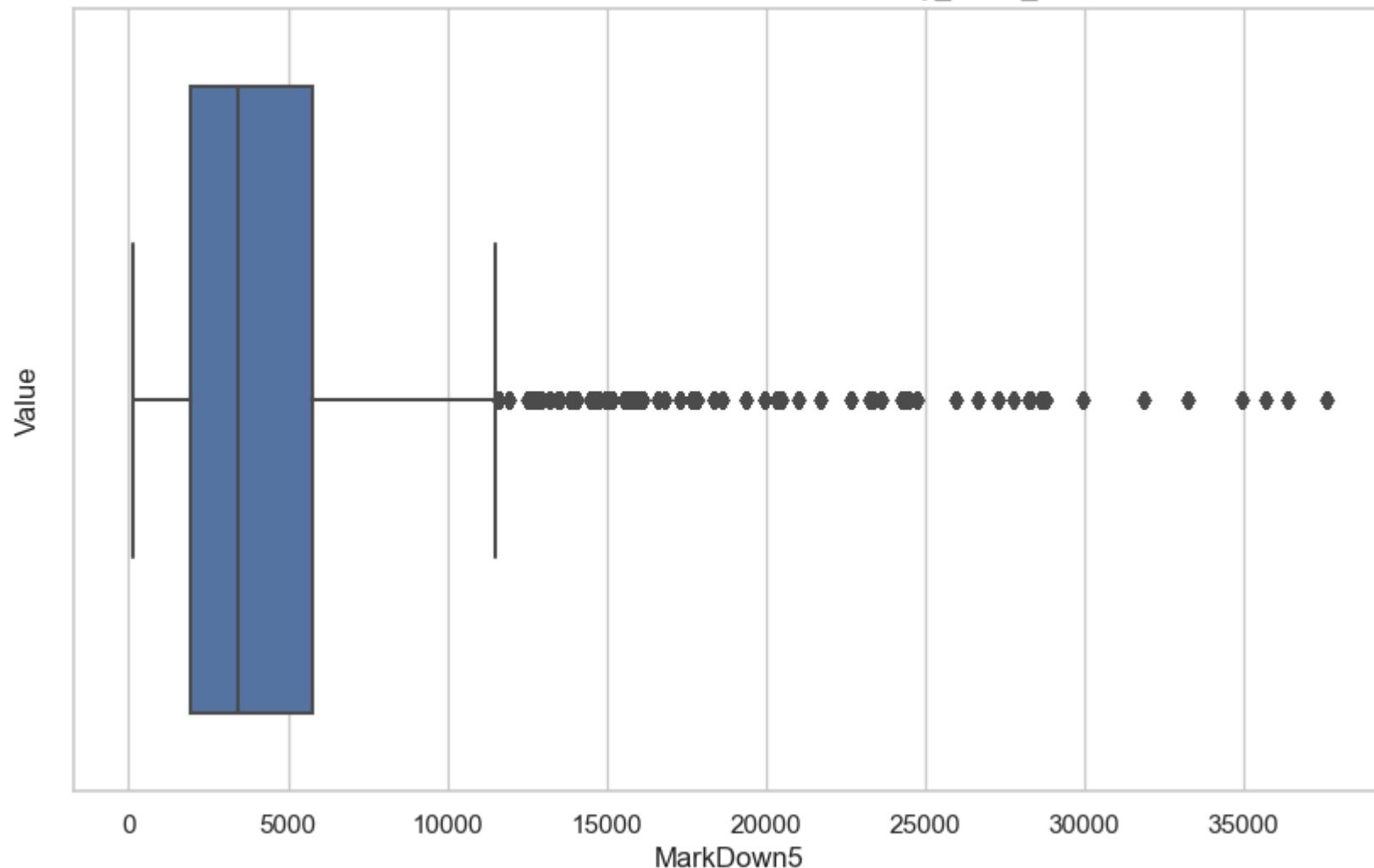


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_4w

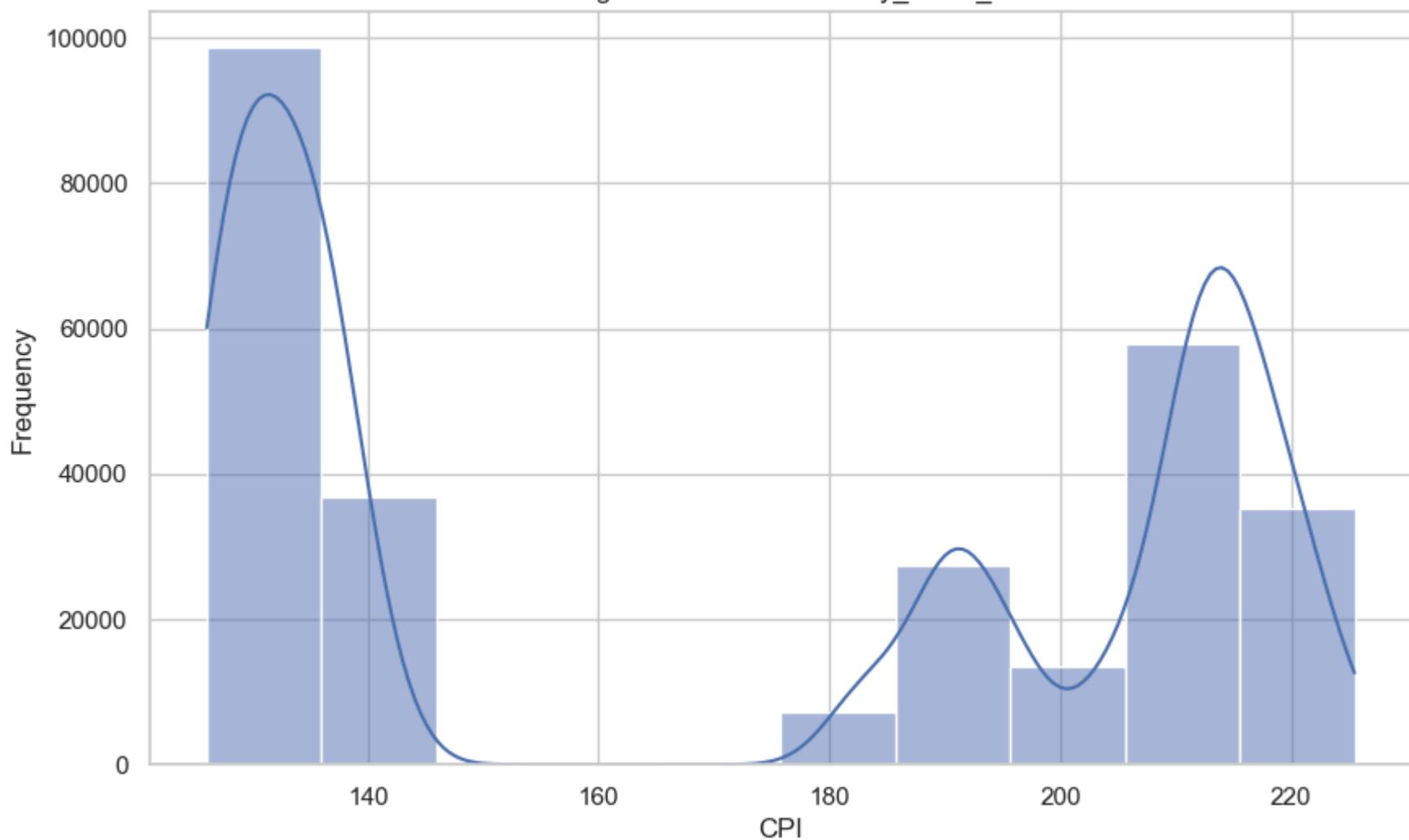


Box Plot of MarkDown5 in Data with Weekly_Sales_4w

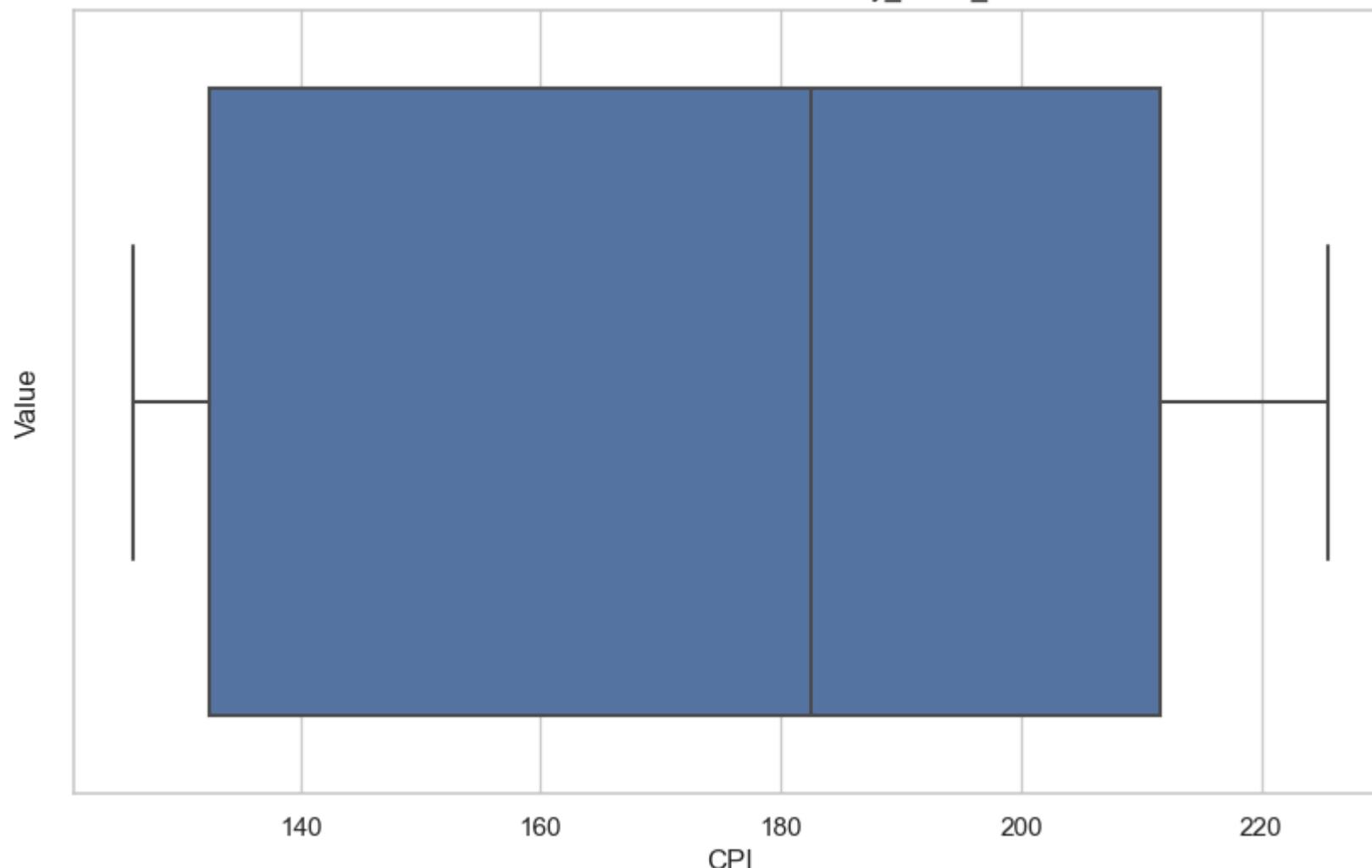


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_4w

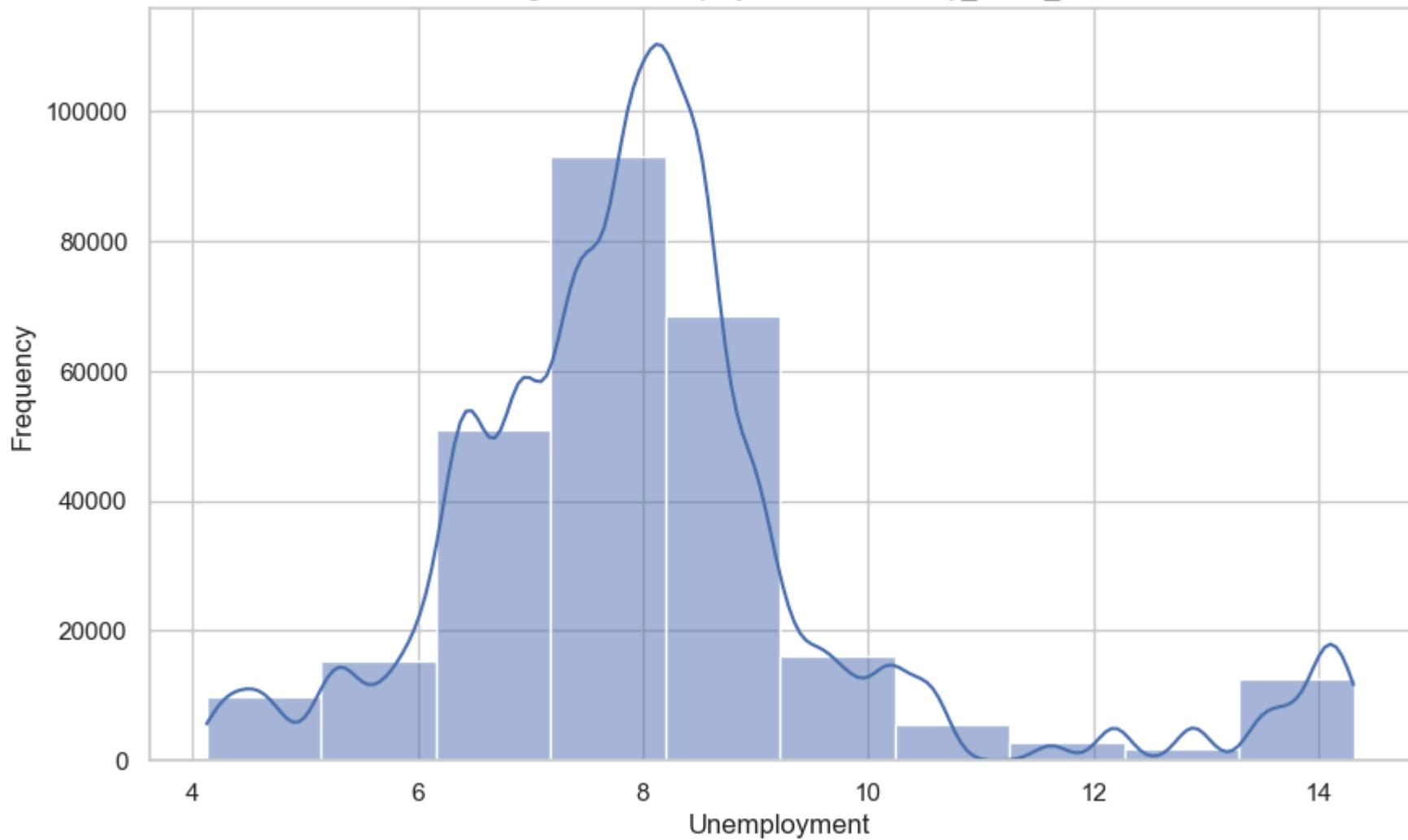


Box Plot of CPI in Data with Weekly_Sales_4w

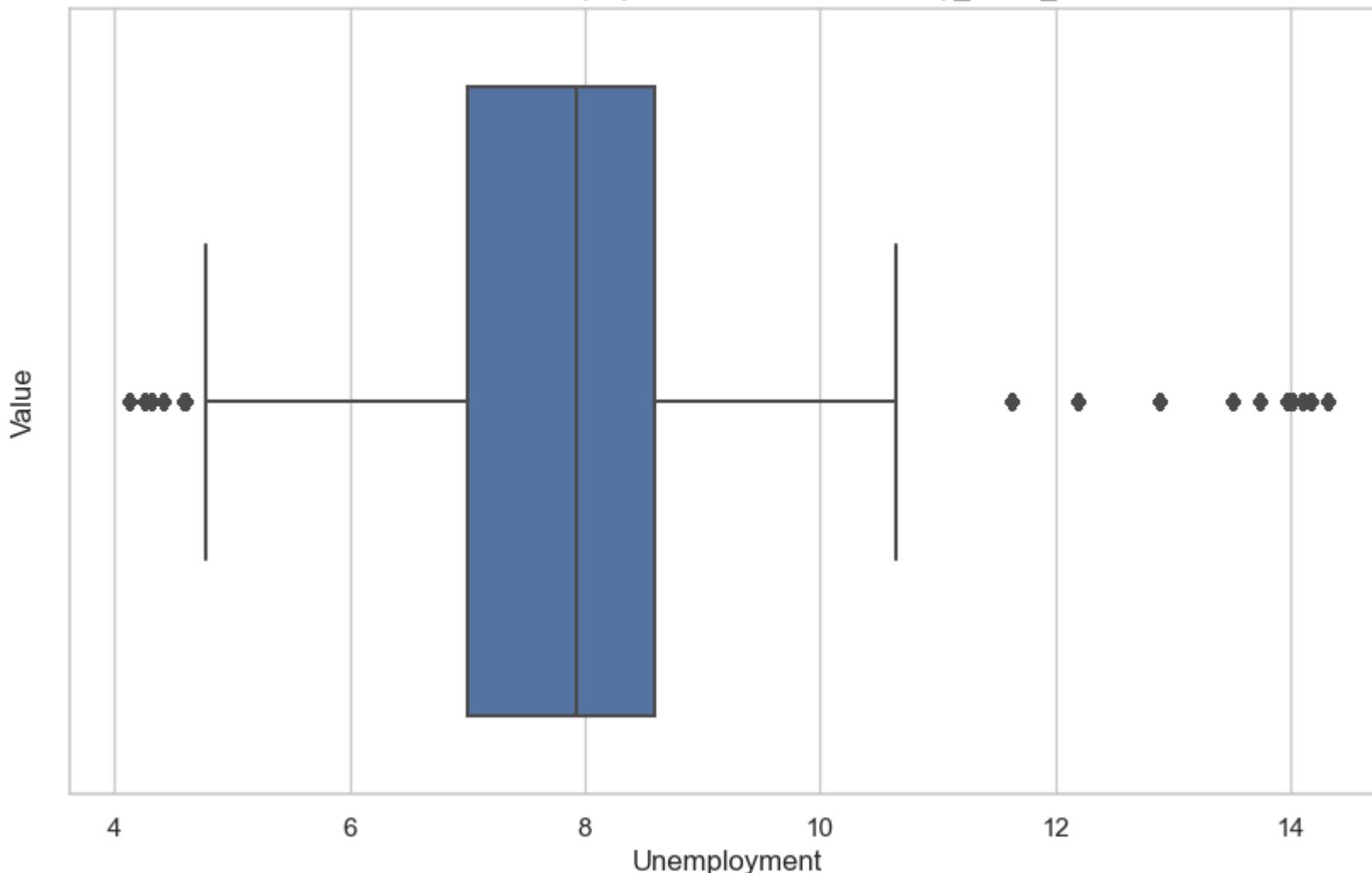


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_4w

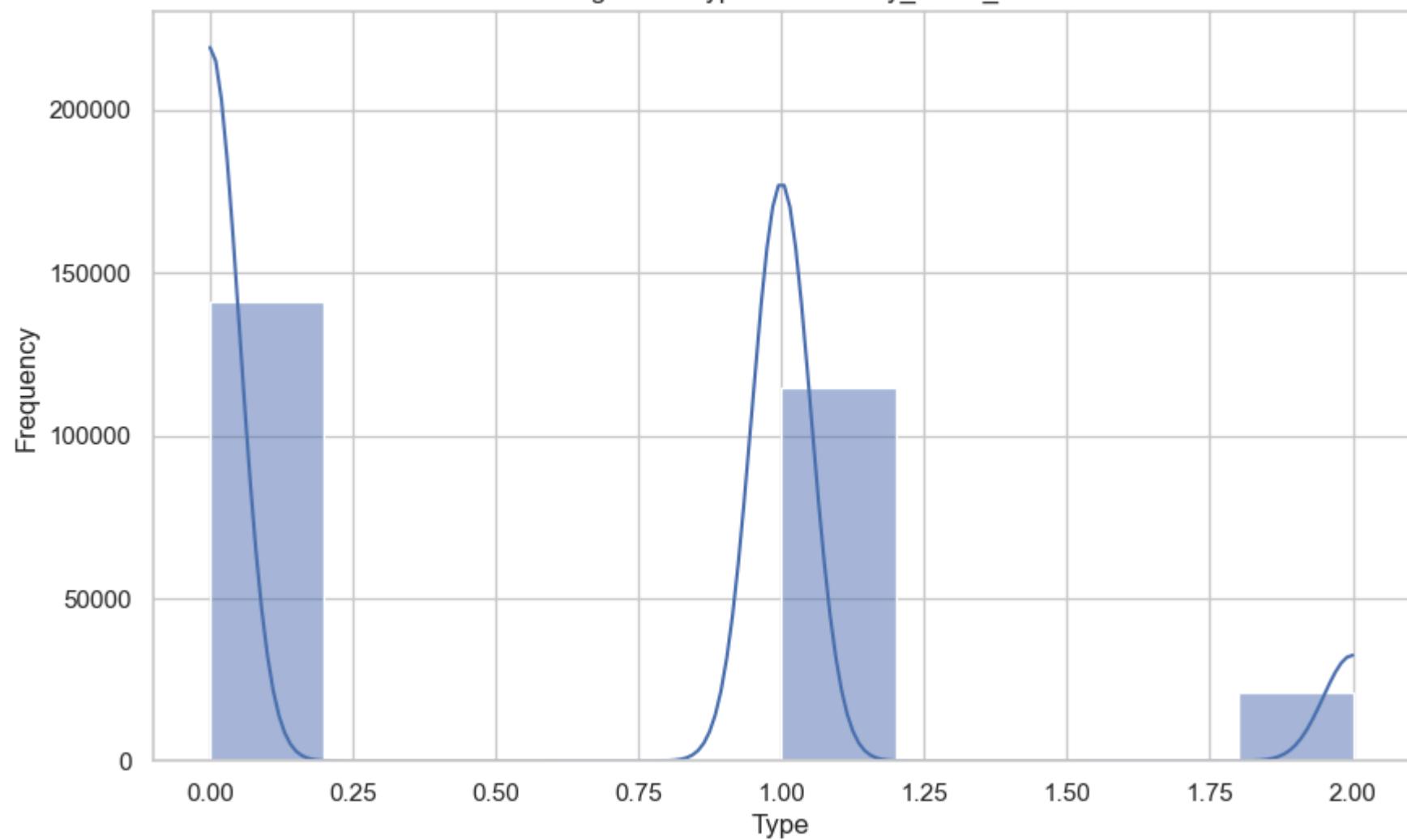


Box Plot of Unemployment in Data with Weekly_Sales_4w

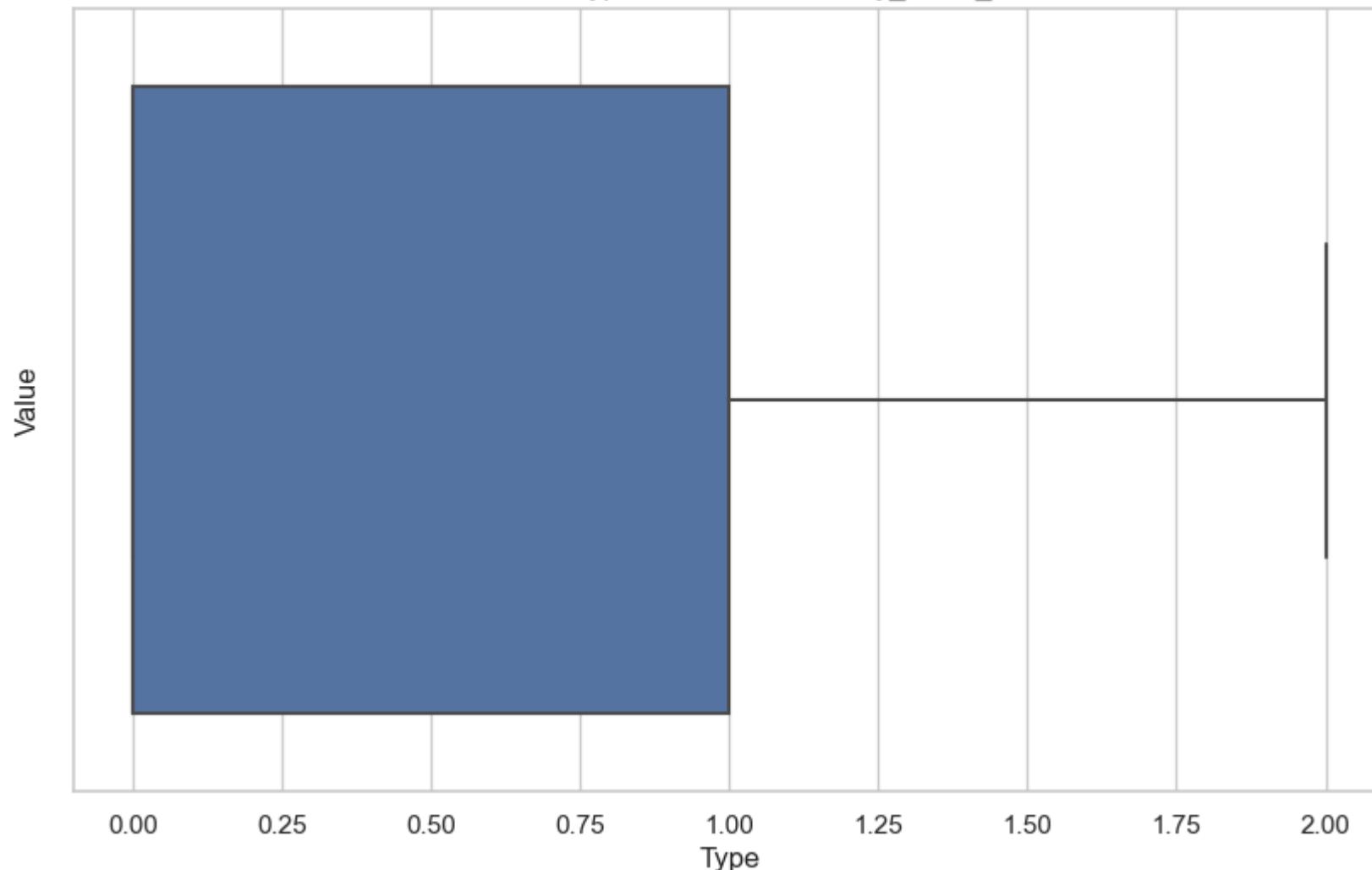


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_4w

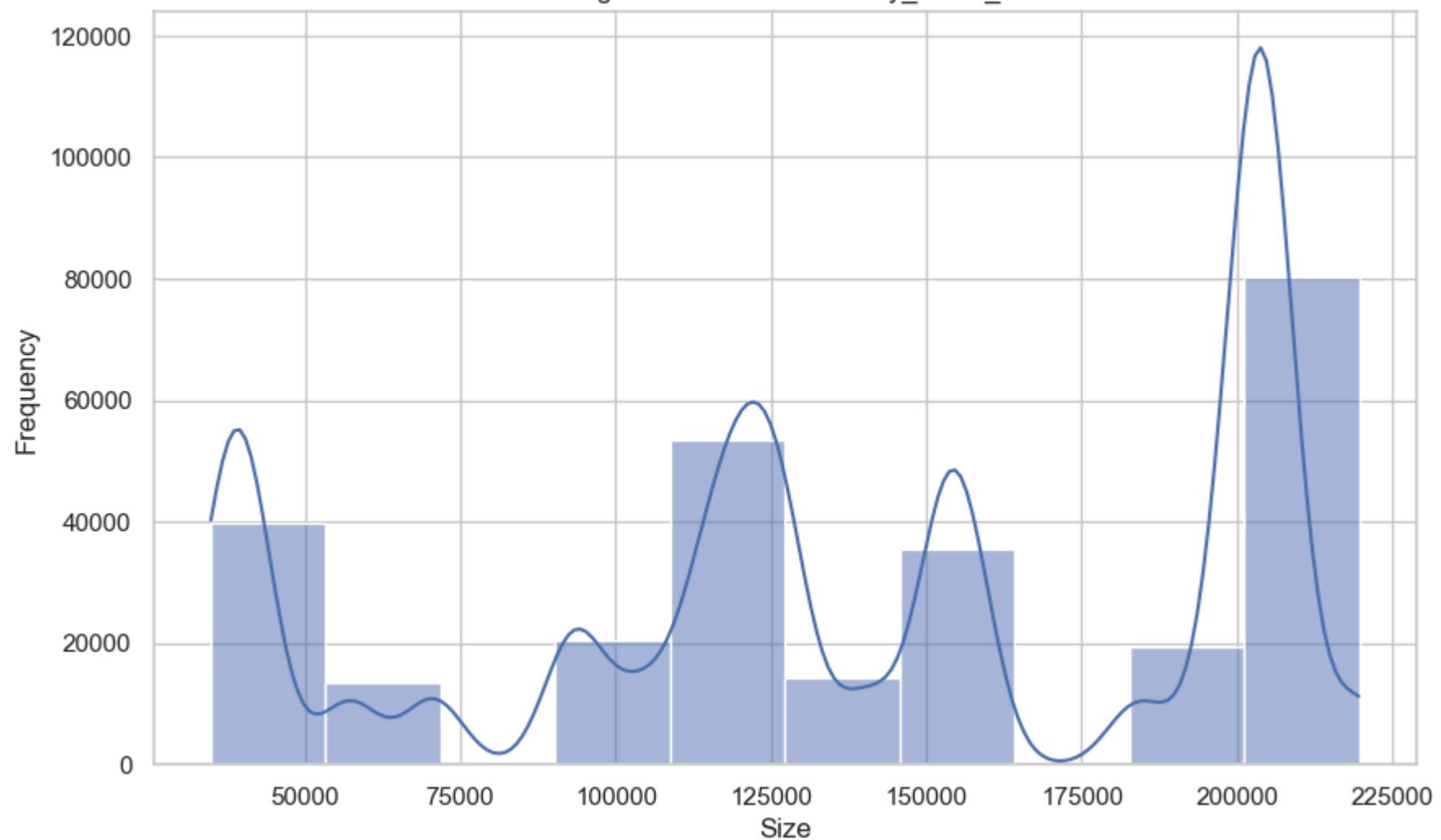


Box Plot of Type in Data with Weekly_Sales_4w

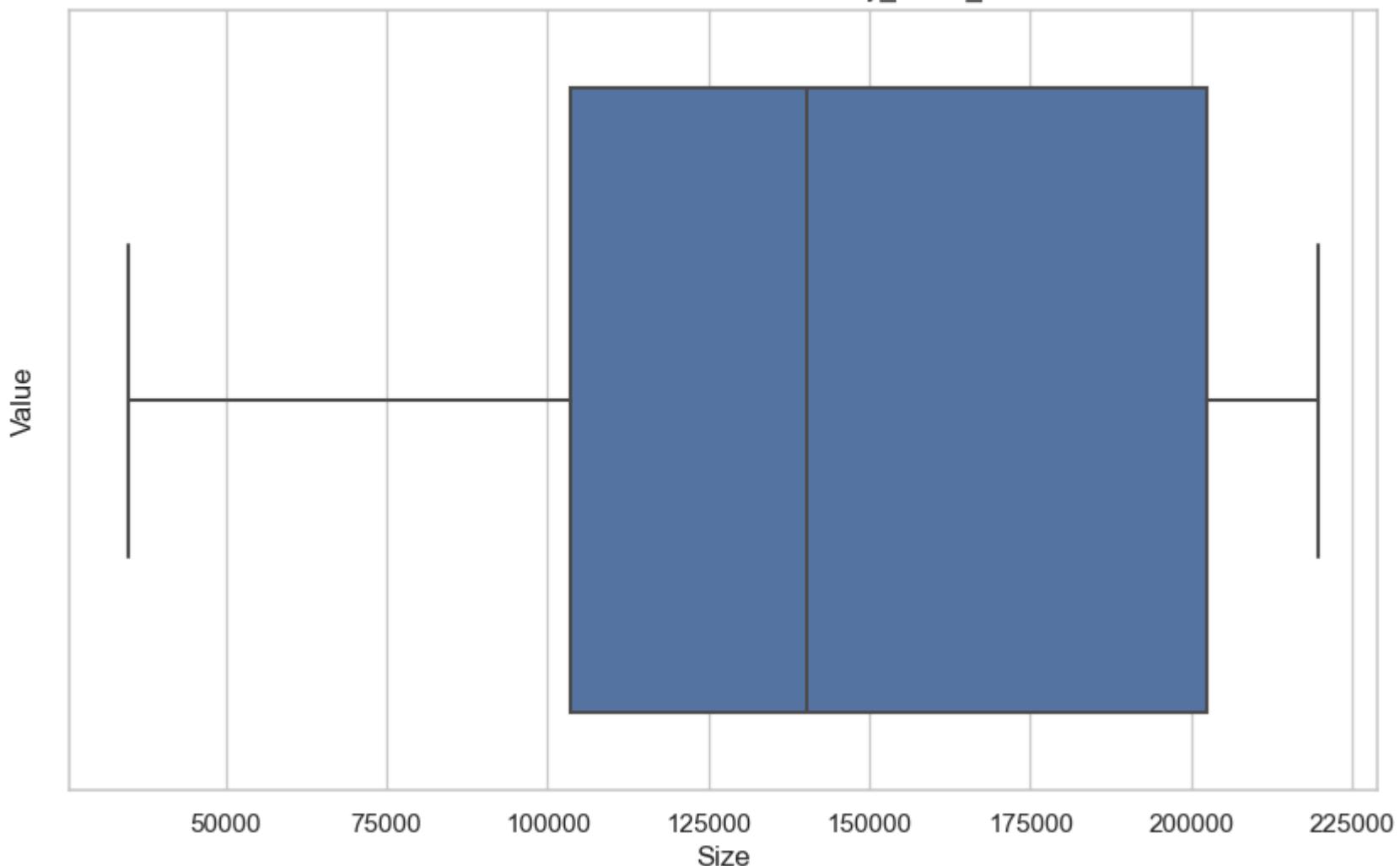


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_4w

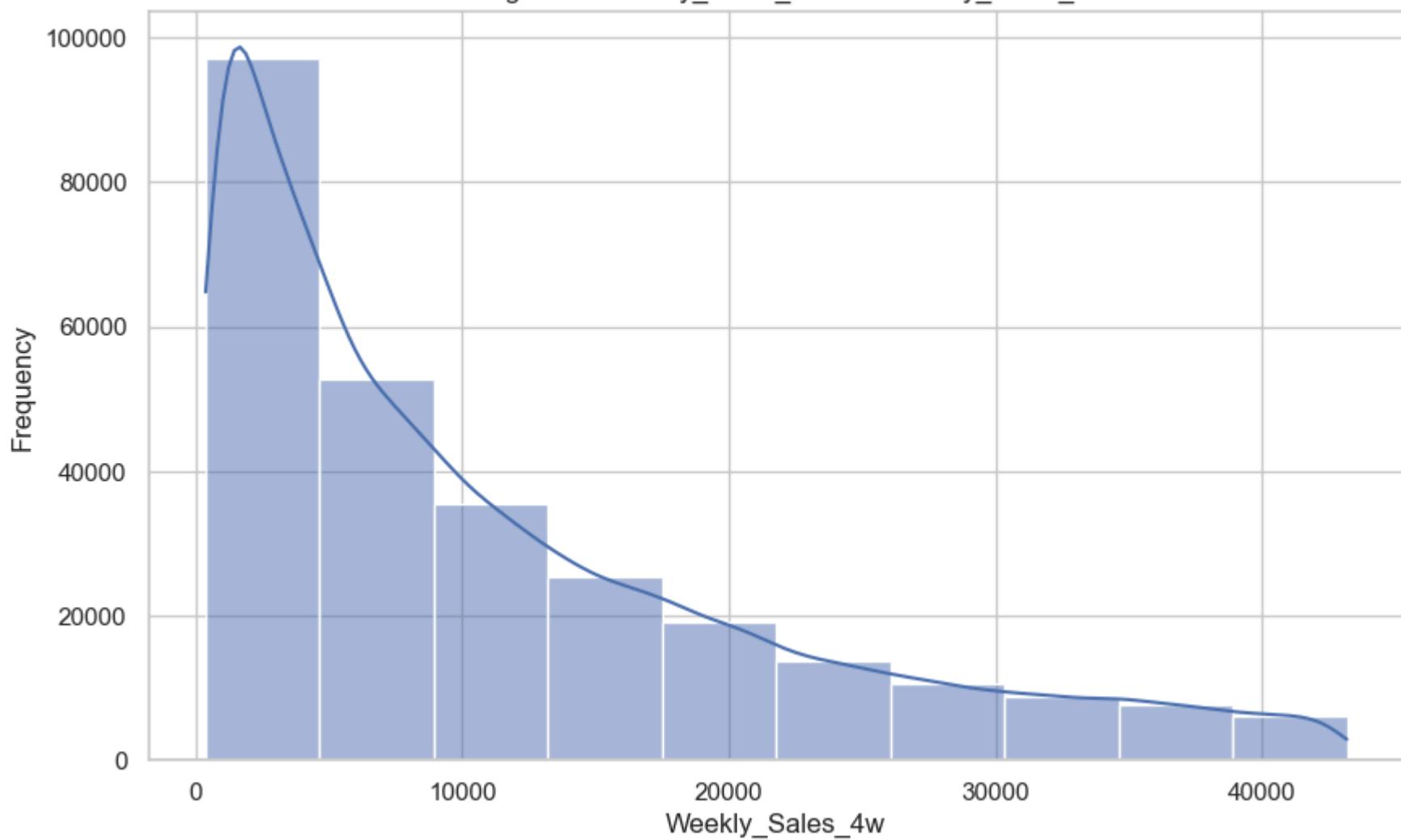


Box Plot of Size in Data with Weekly_Sales_4w

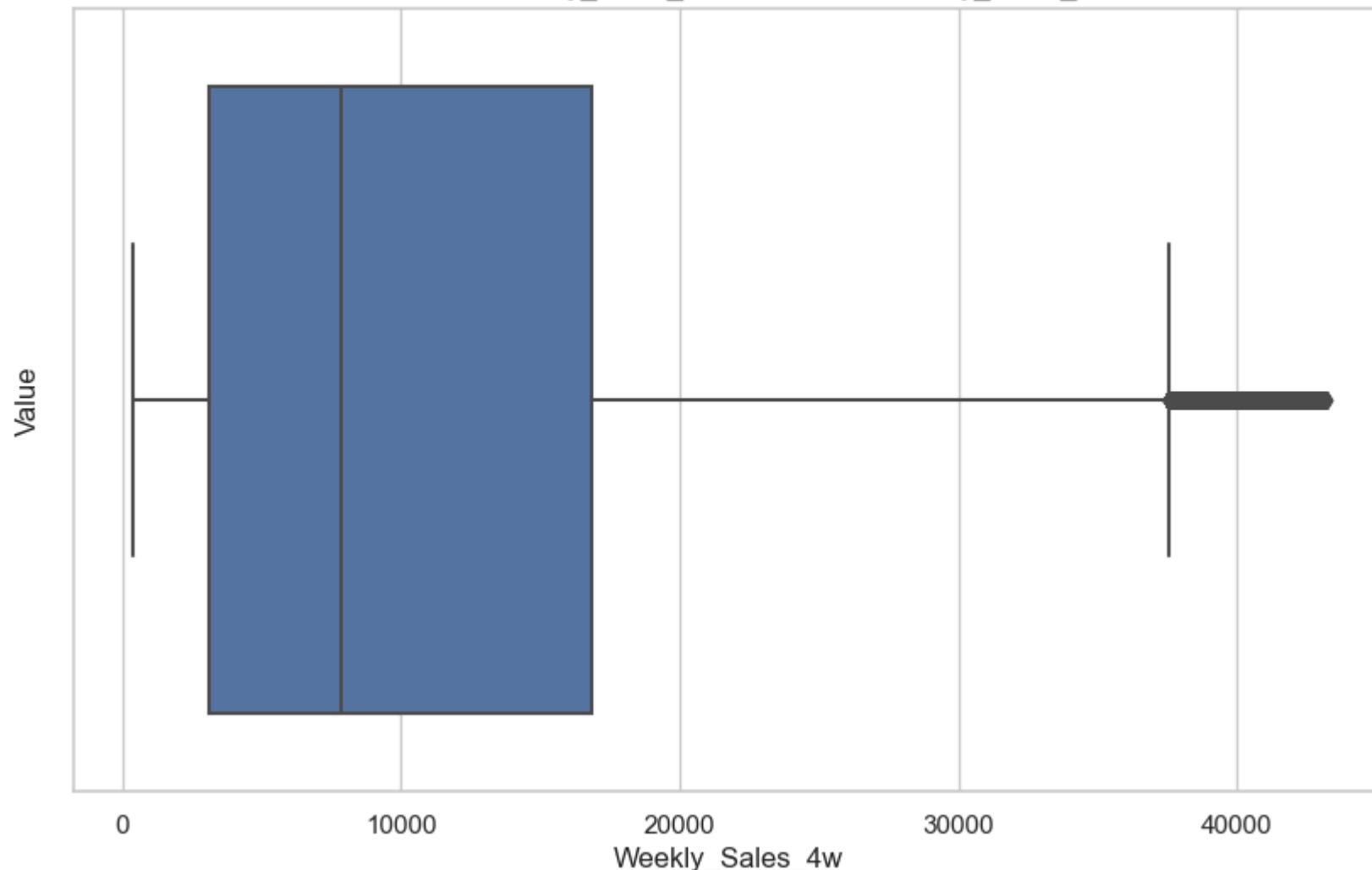


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_4w with Weekly_Sales_4w

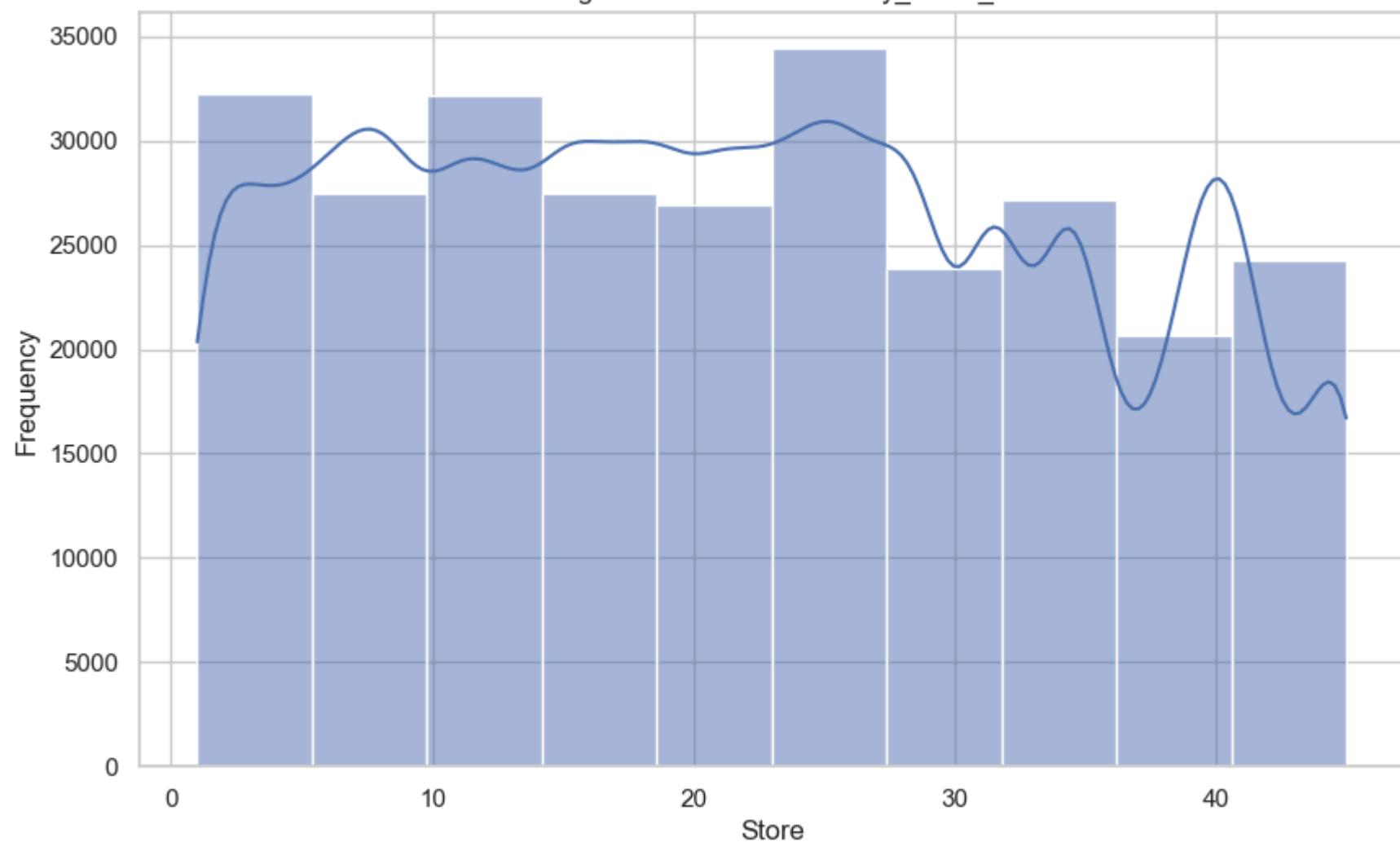


Box Plot of Weekly_Sales_4w in Data with Weekly_Sales_4w

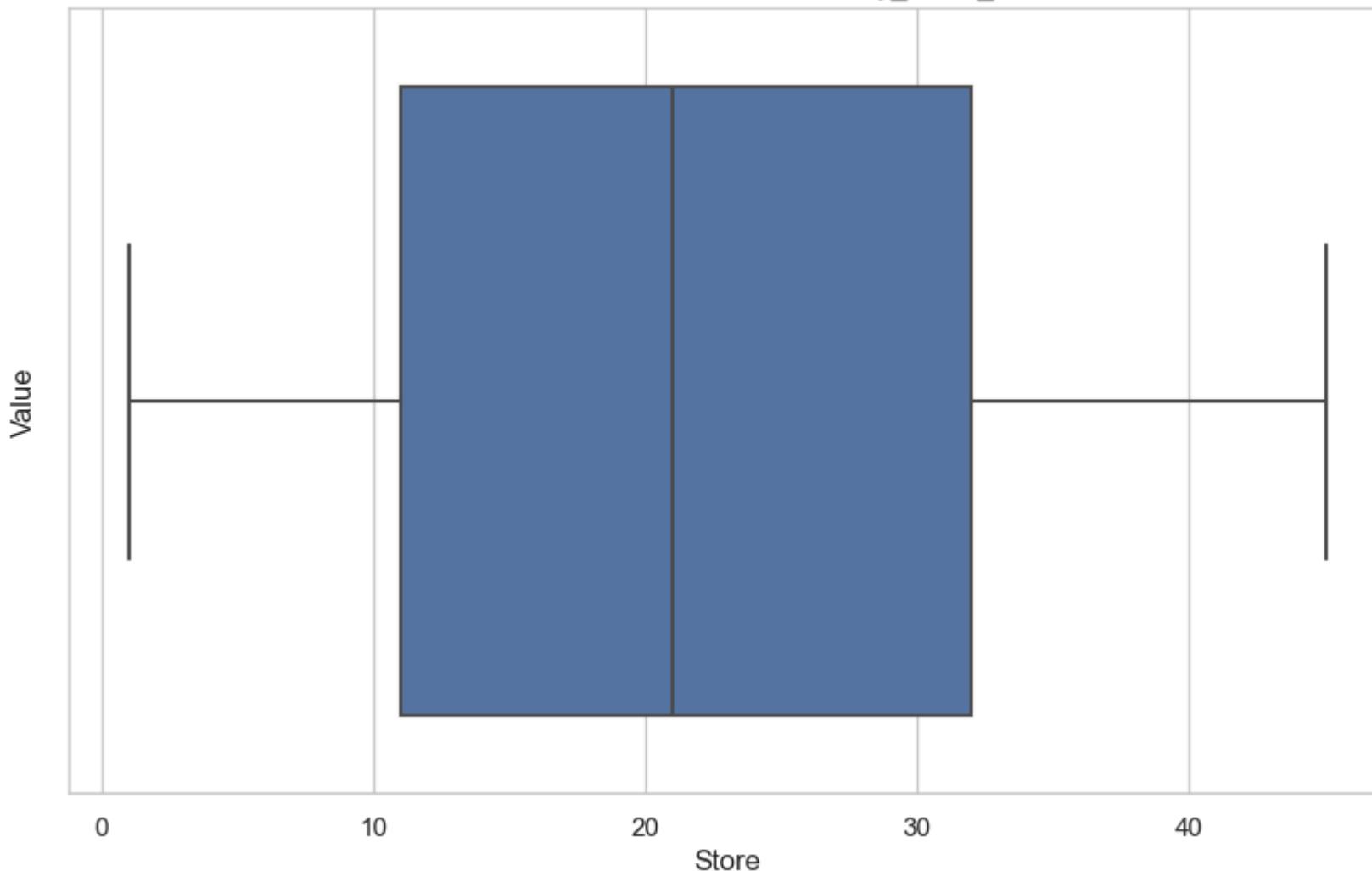


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_5w

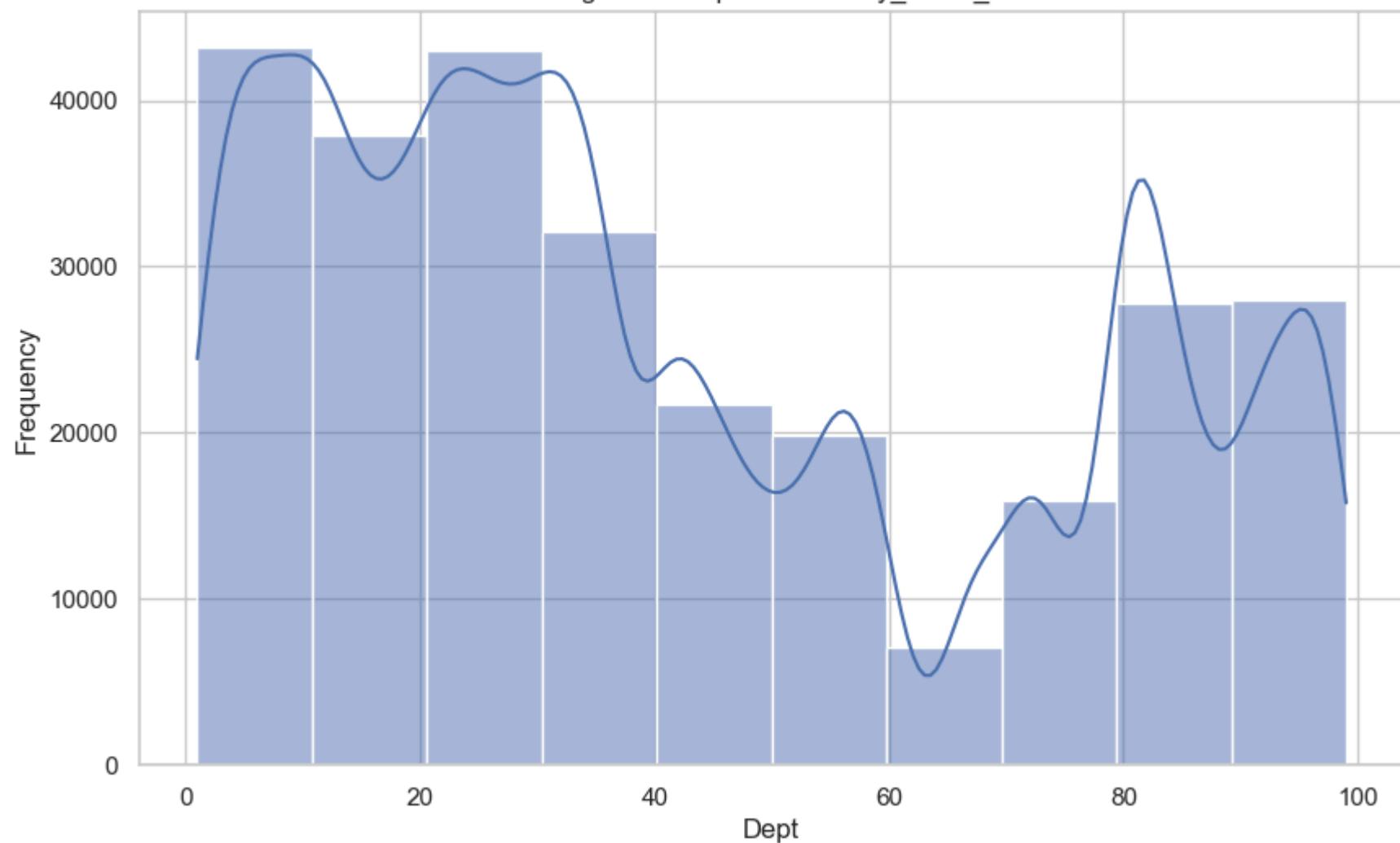


Box Plot of Store in Data with Weekly_Sales_5w

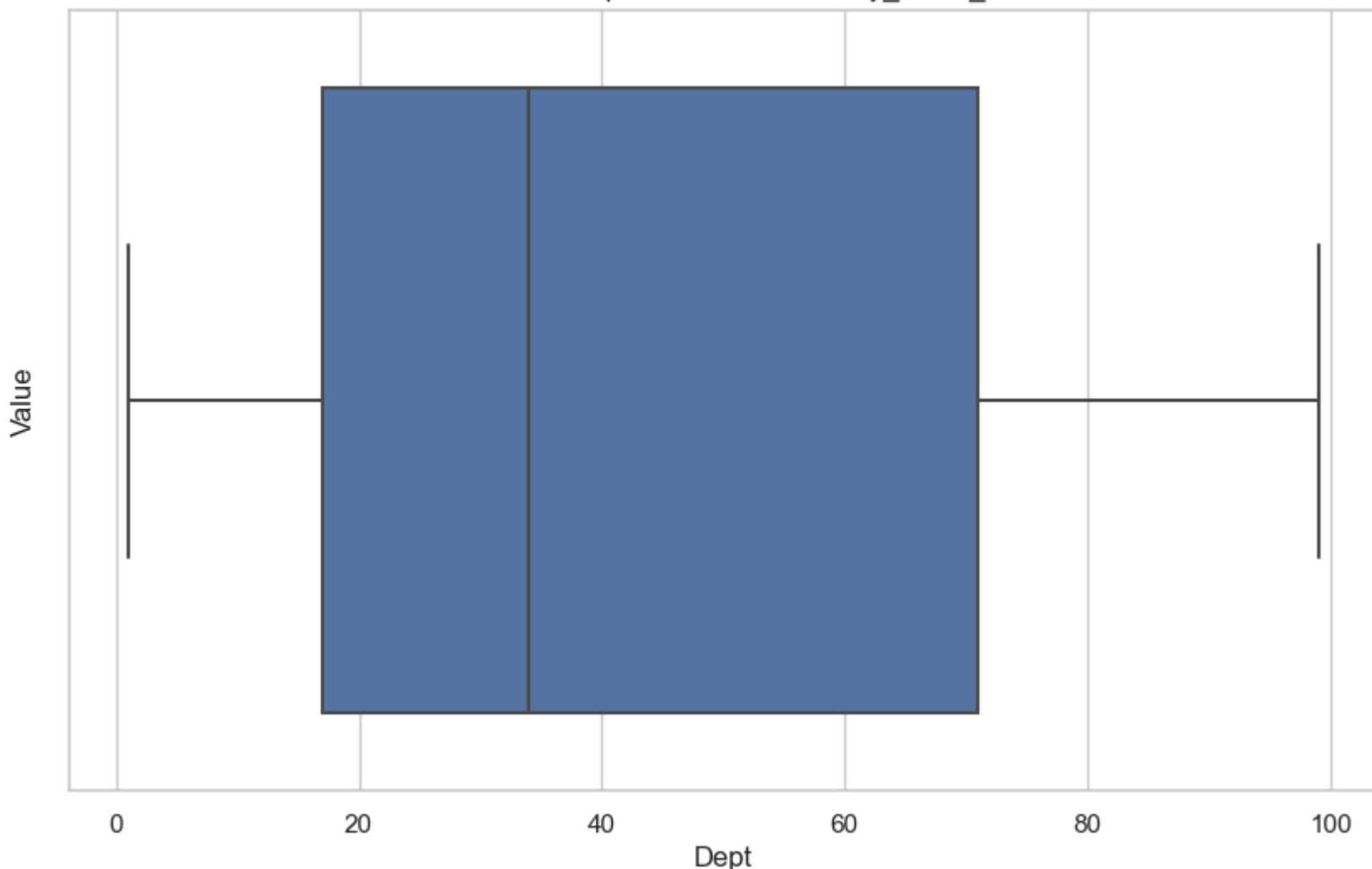


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_5w

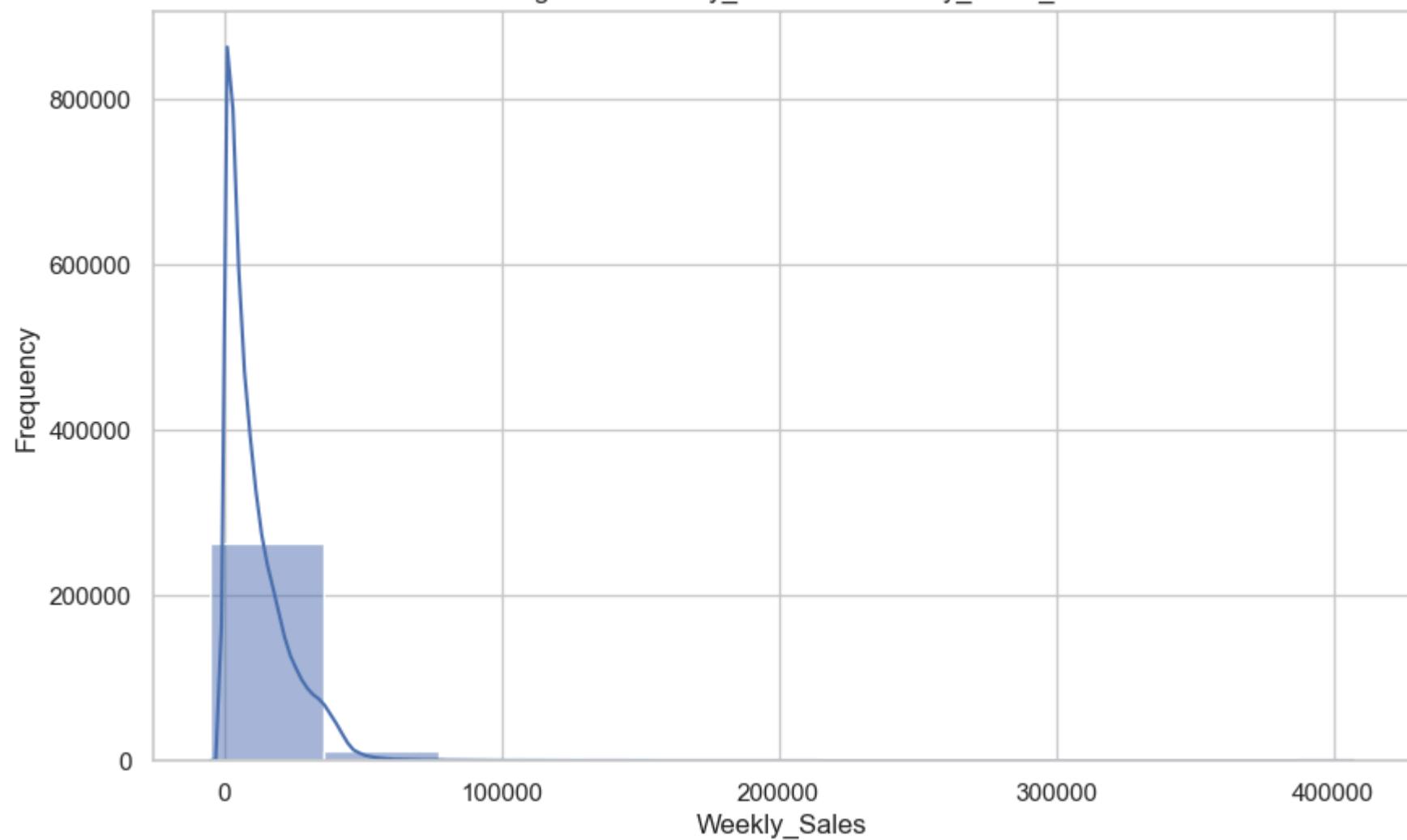


Box Plot of Dept in Data with Weekly_Sales_5w

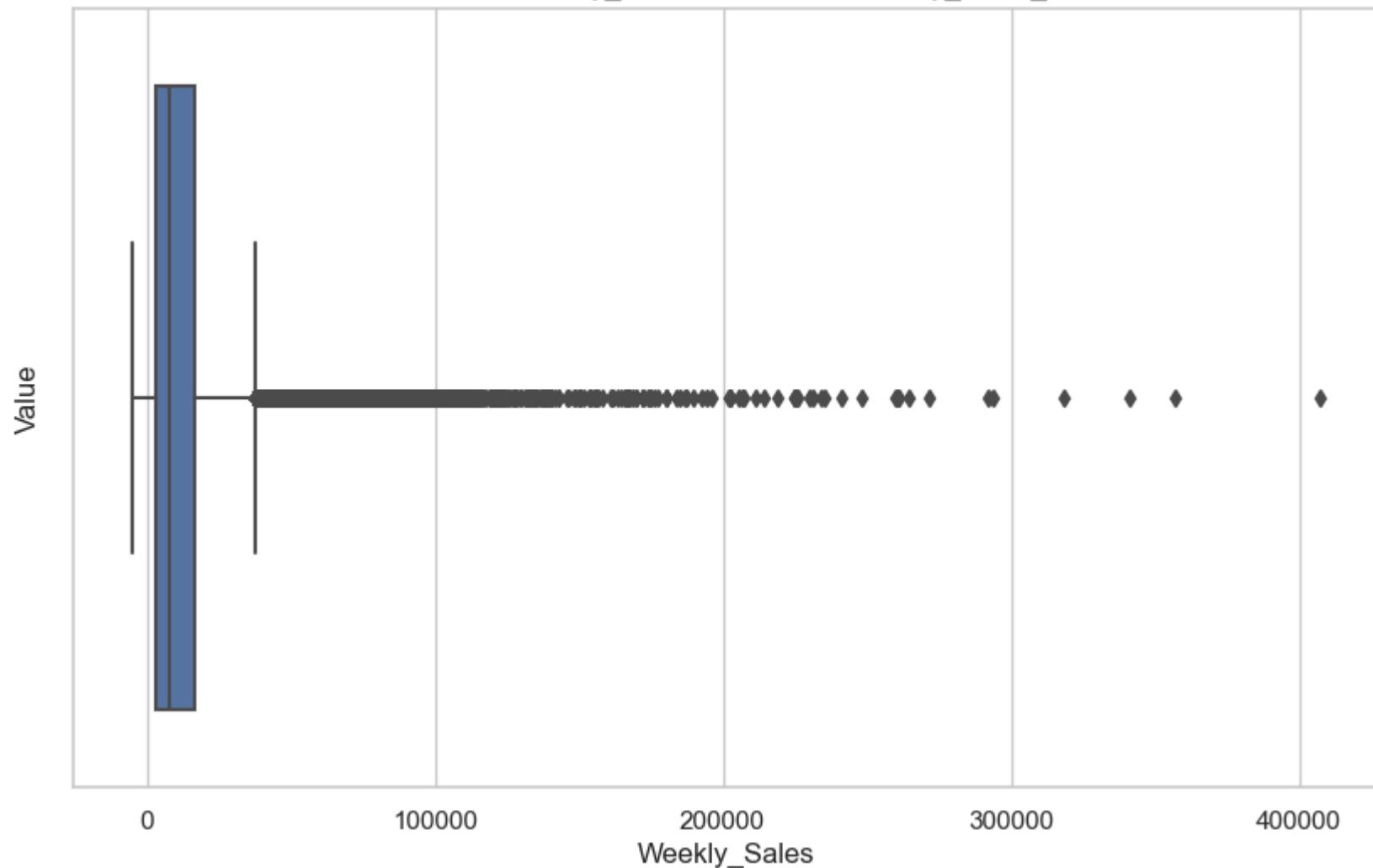


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_5w

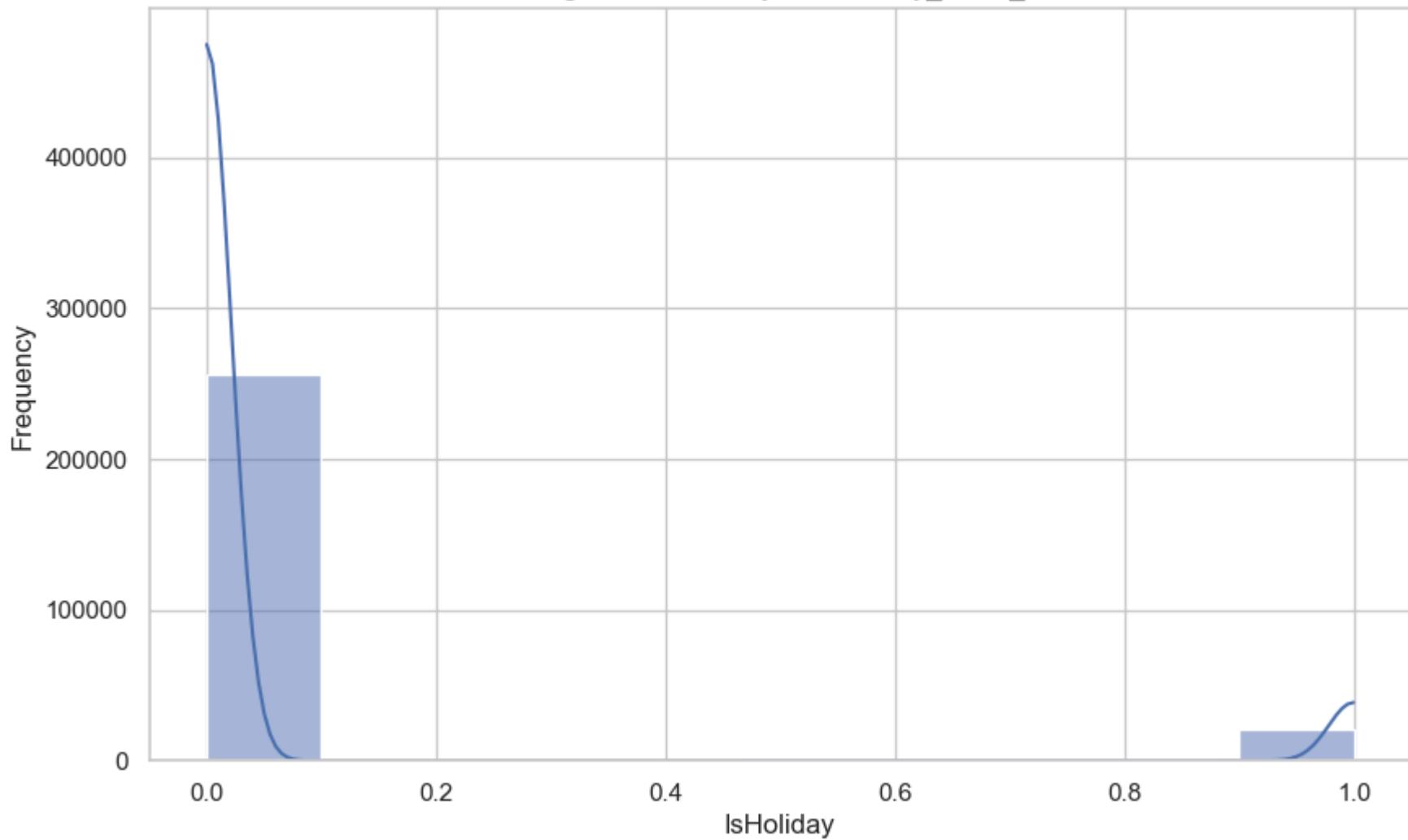


Box Plot of Weekly_Sales in Data with Weekly_Sales_5w

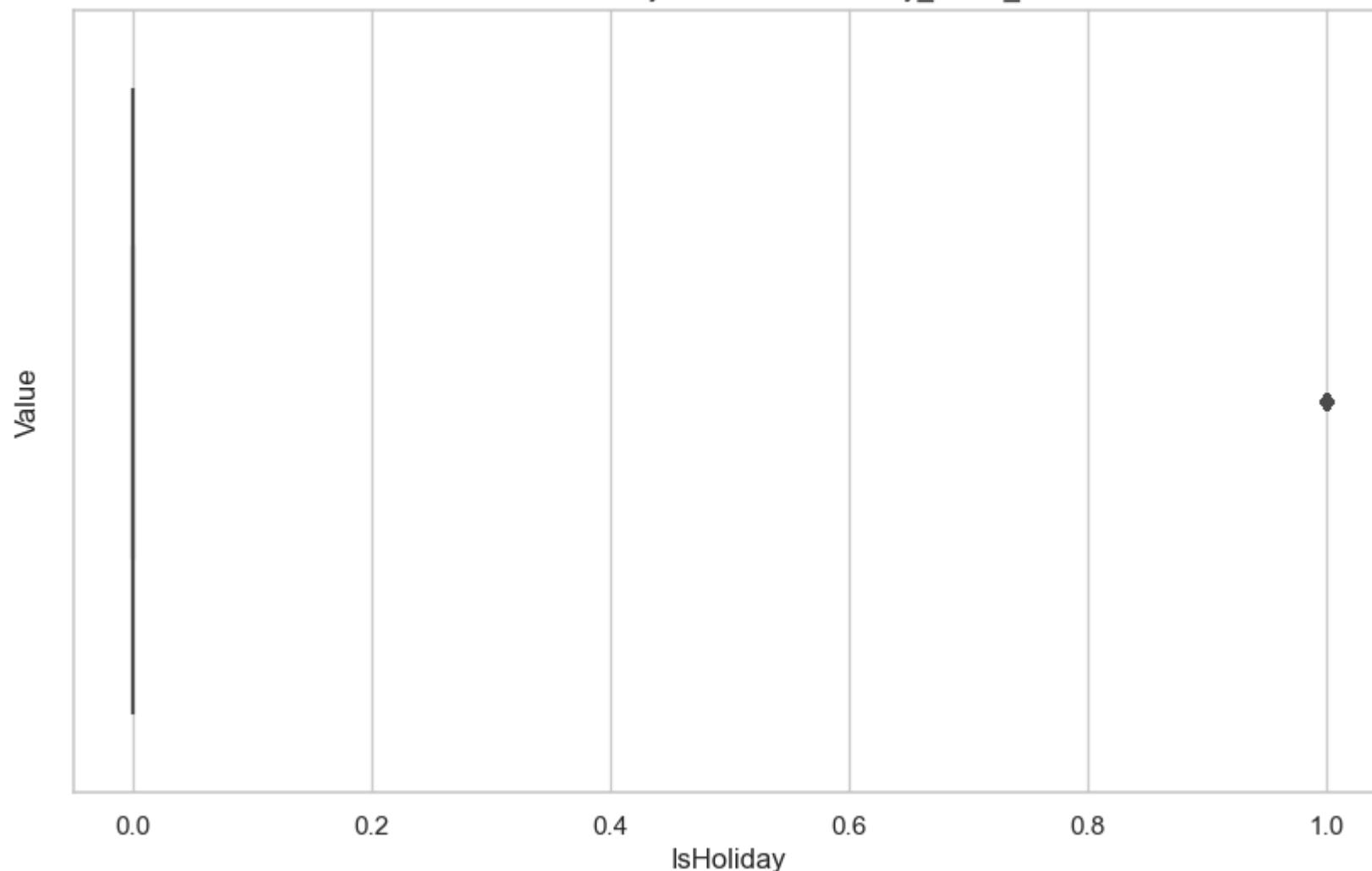


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_5w

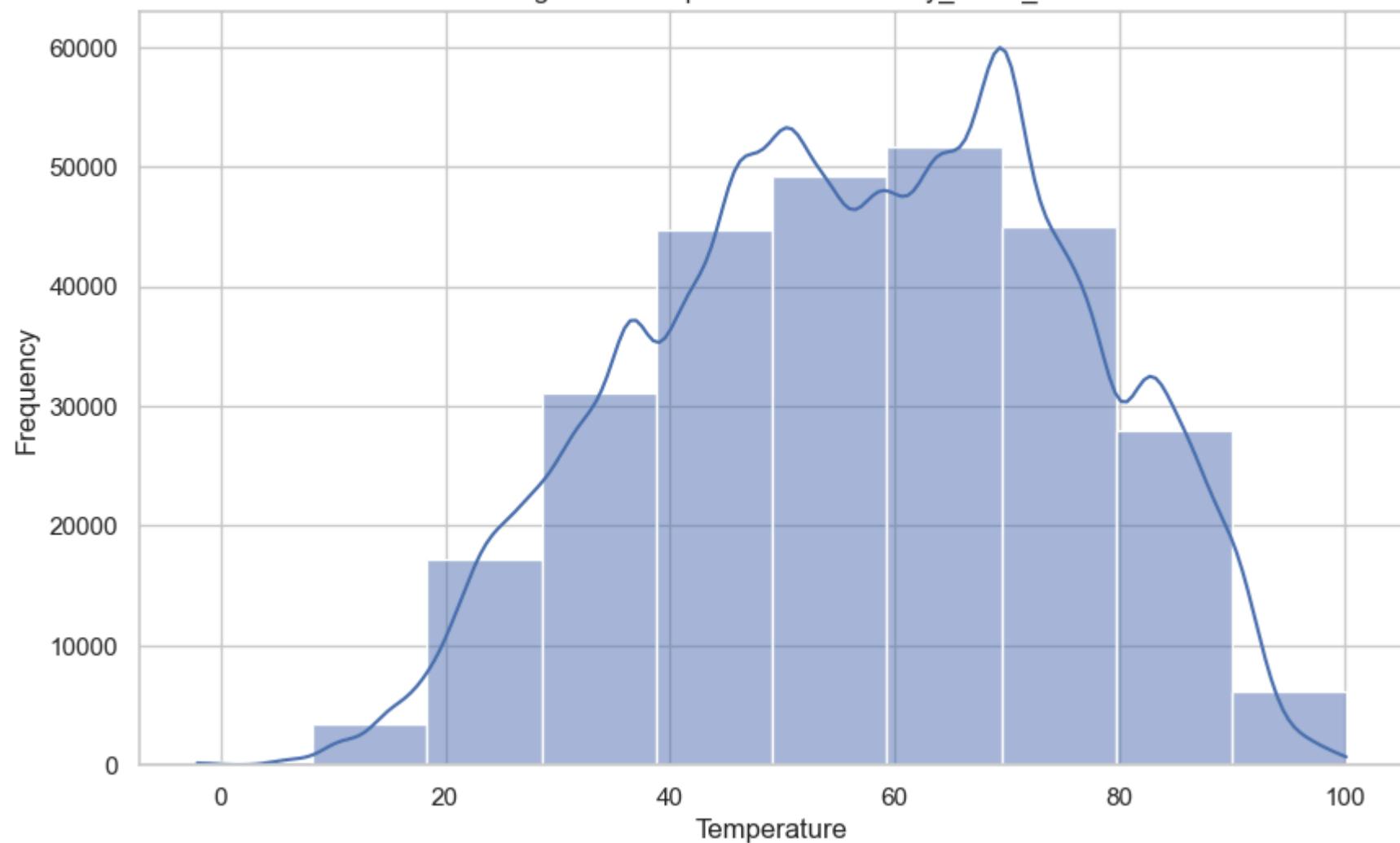


Box Plot of IsHoliday in Data with Weekly_Sales_5w

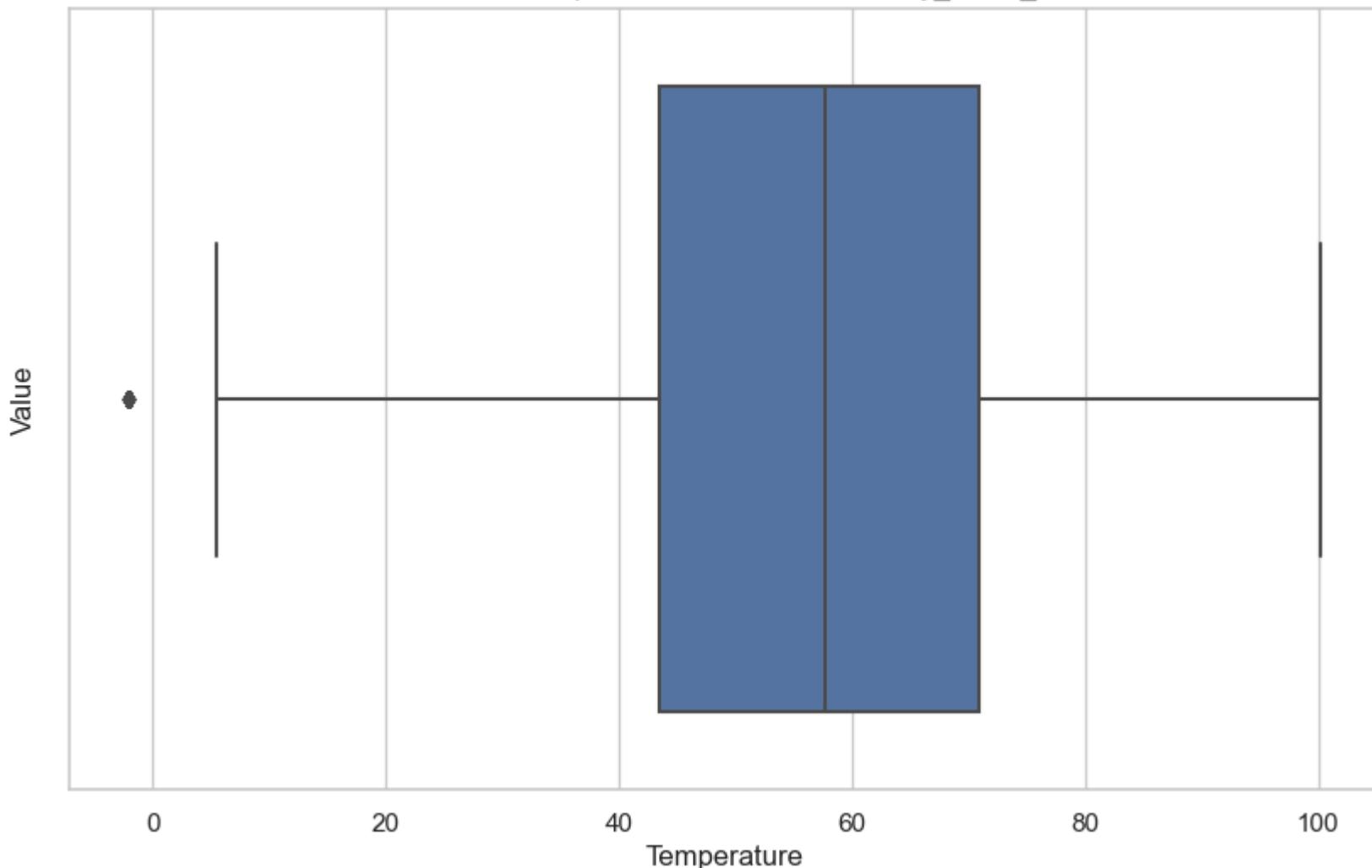


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_5w

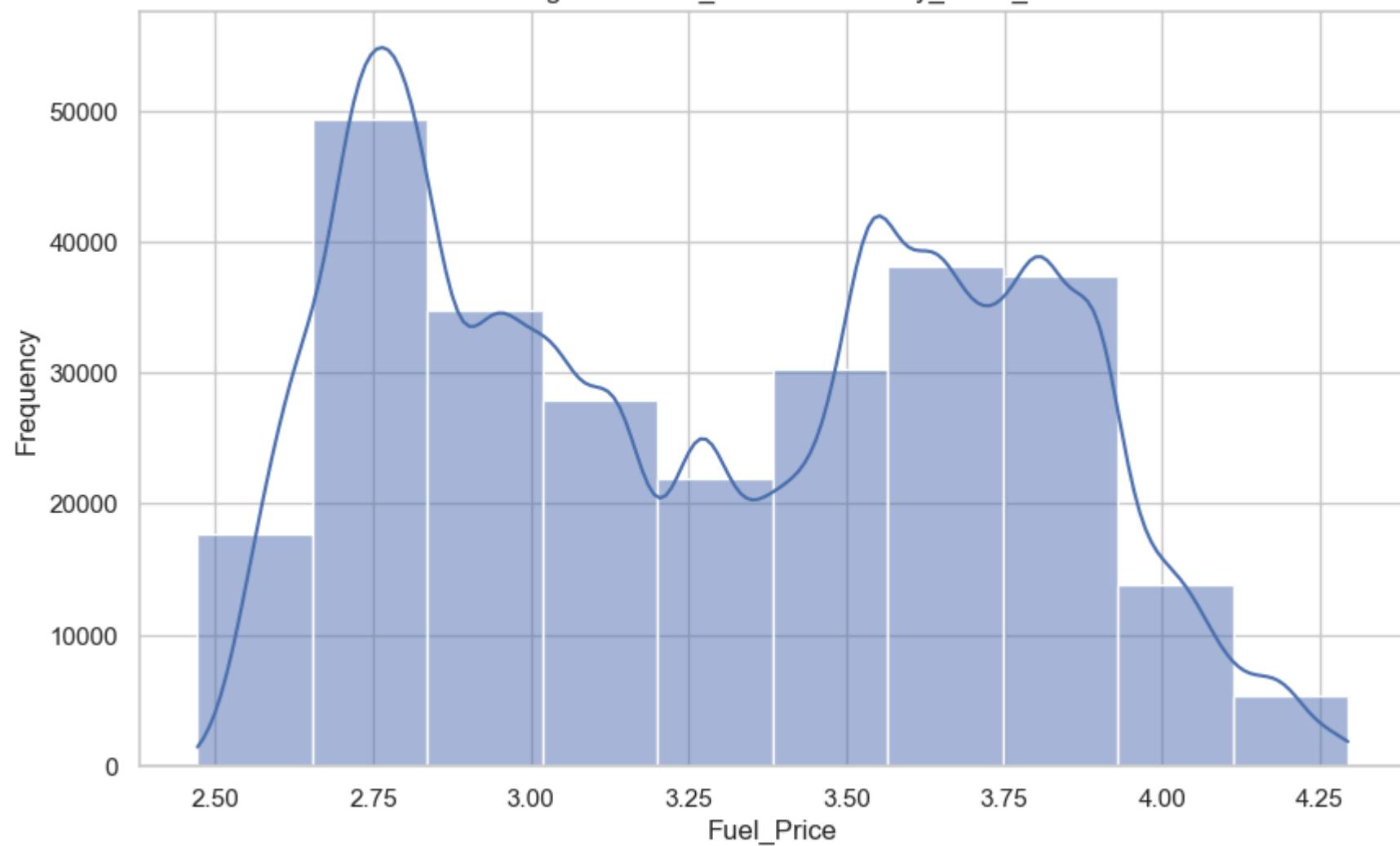


Box Plot of Temperature in Data with Weekly_Sales_5w

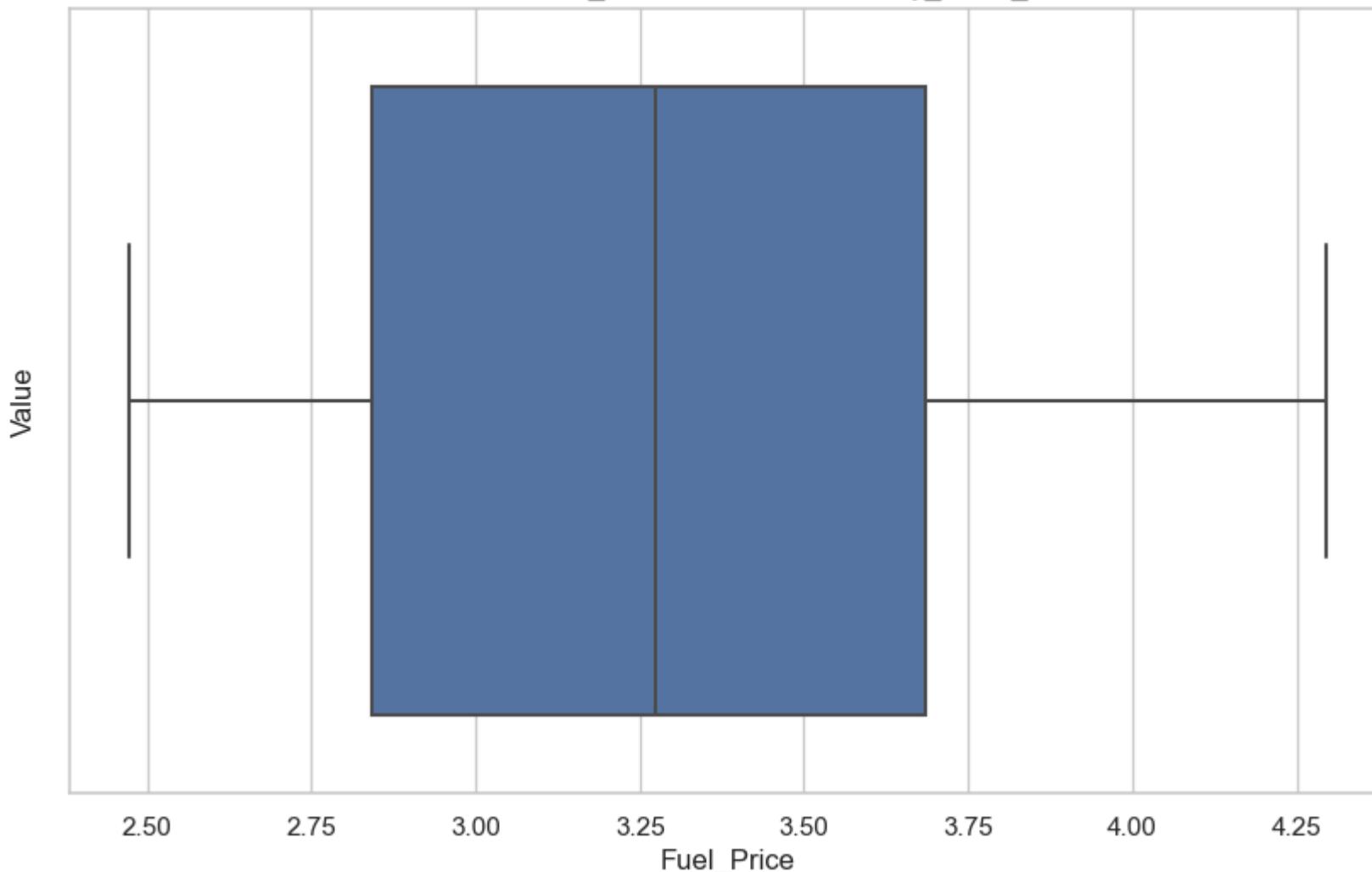


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

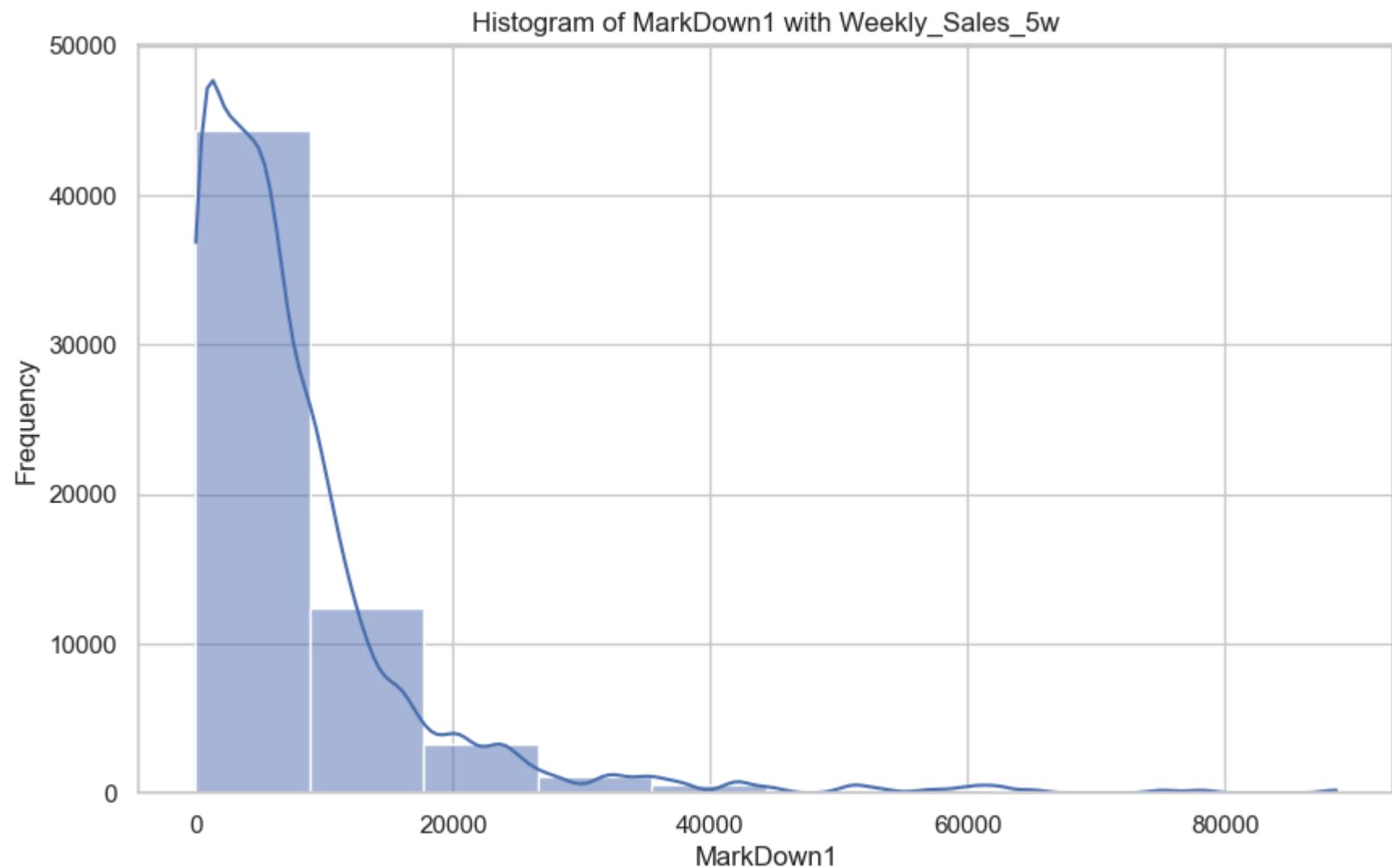
Histogram of Fuel_Price with Weekly_Sales_5w



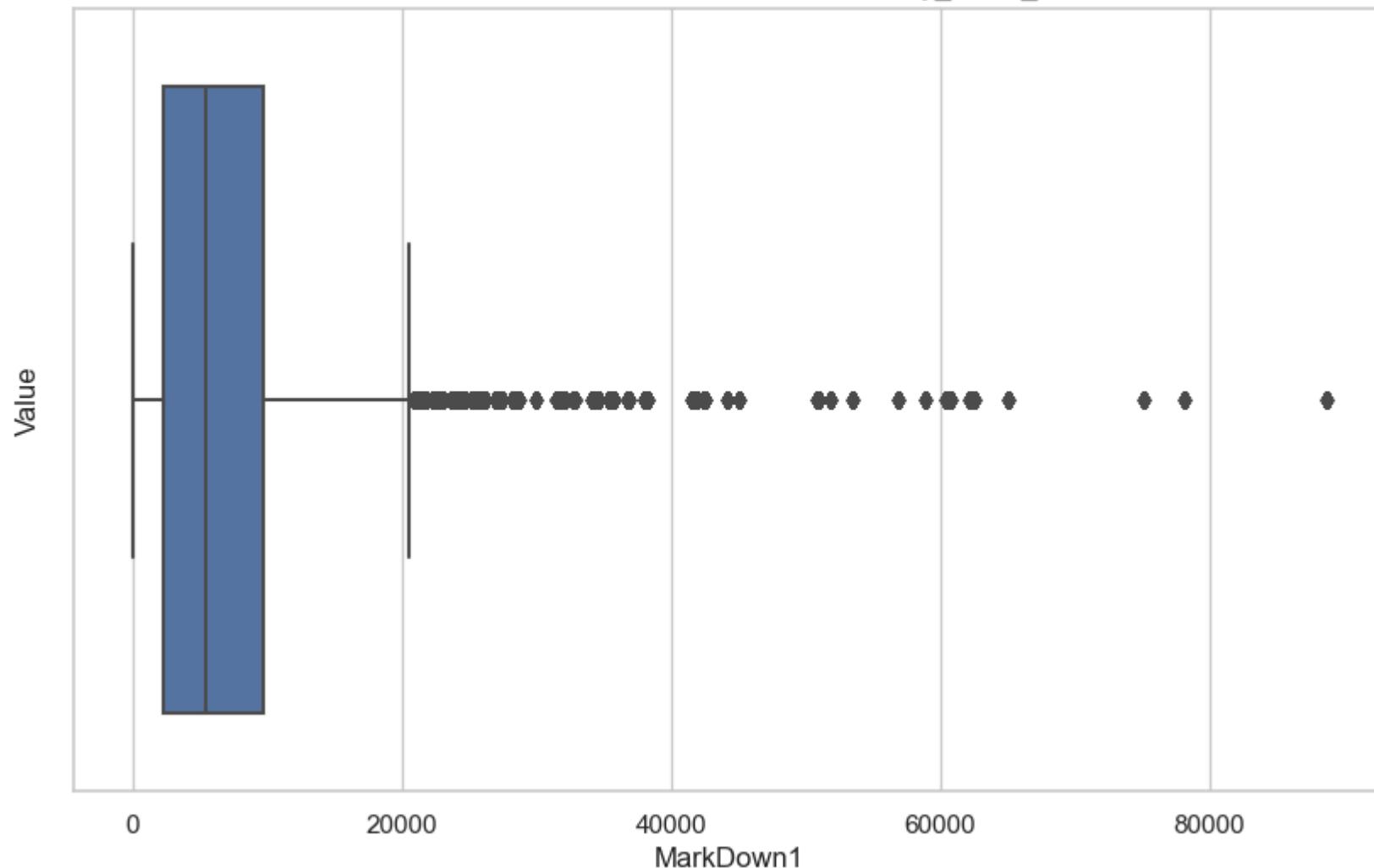
Box Plot of Fuel_Price in Data with Weekly_Sales_5w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

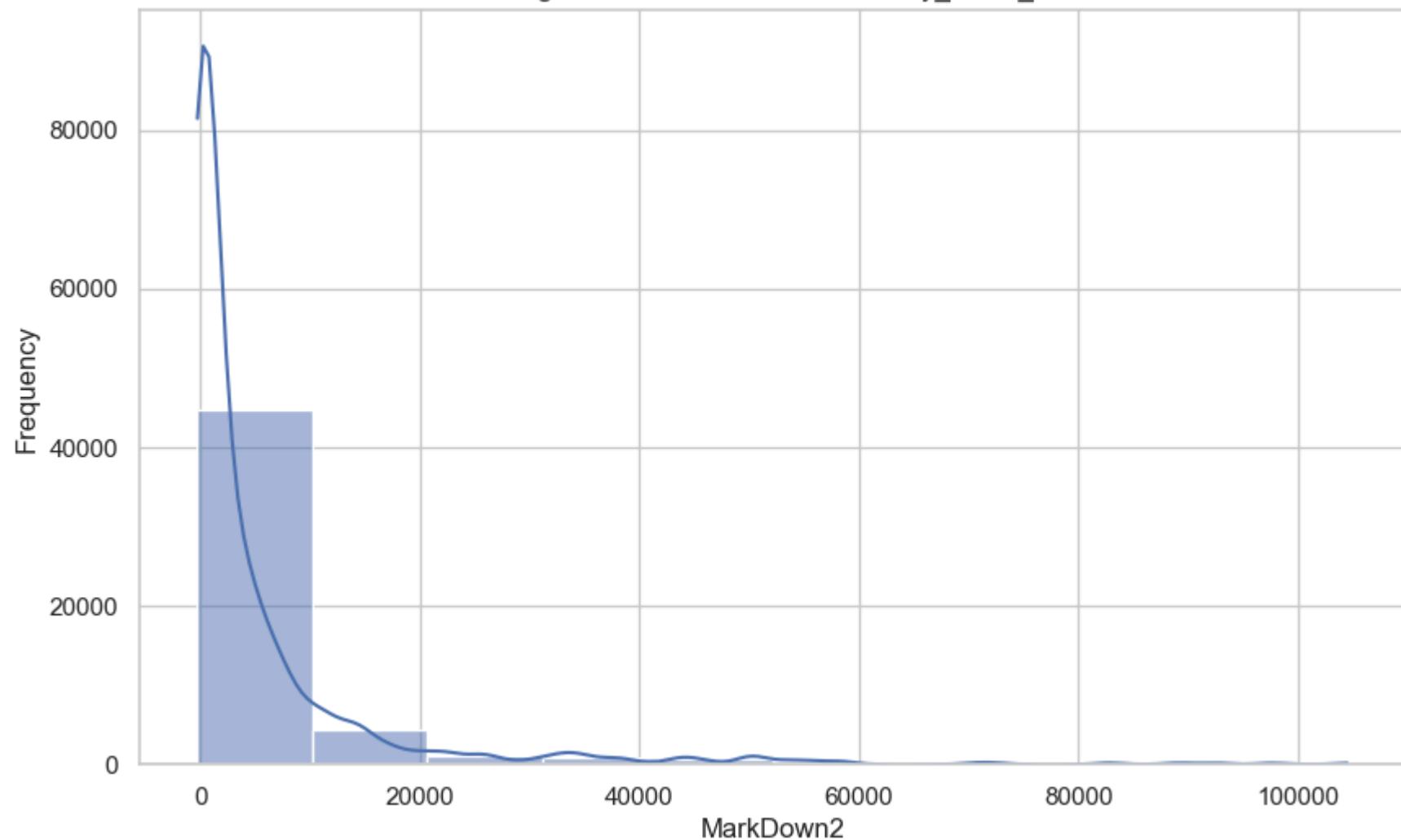


Box Plot of MarkDown1 in Data with Weekly_Sales_5w

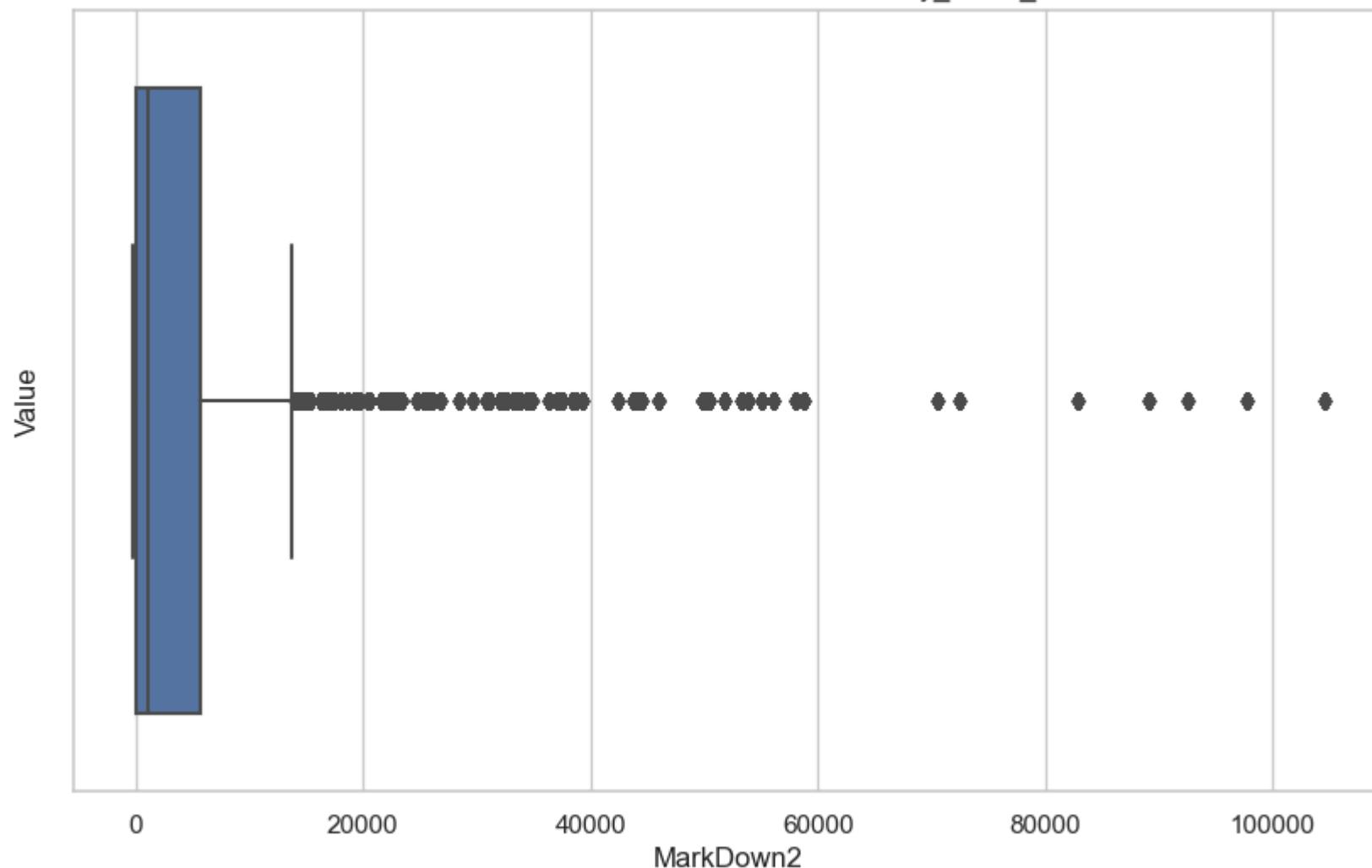


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_5w

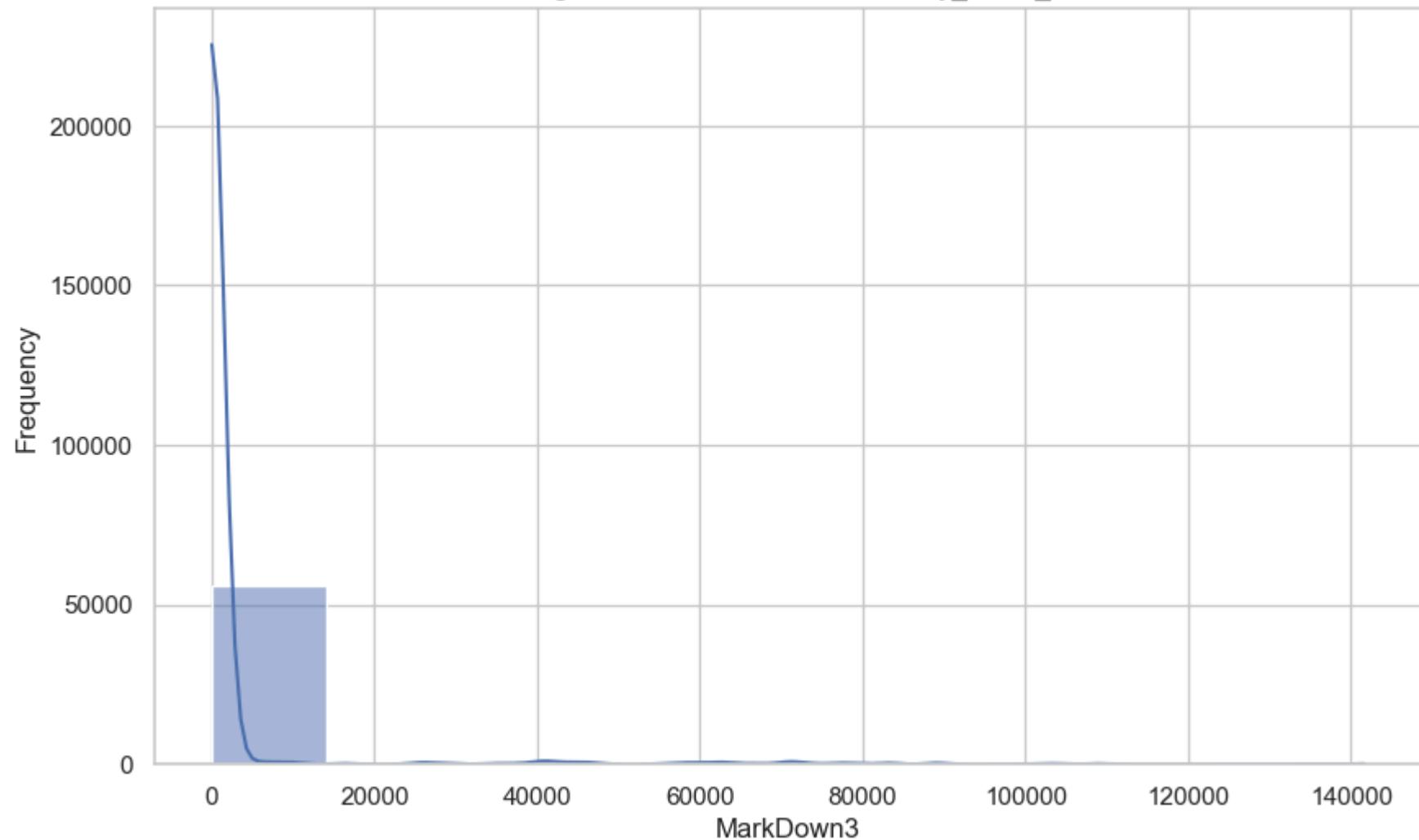


Box Plot of MarkDown2 in Data with Weekly_Sales_5w

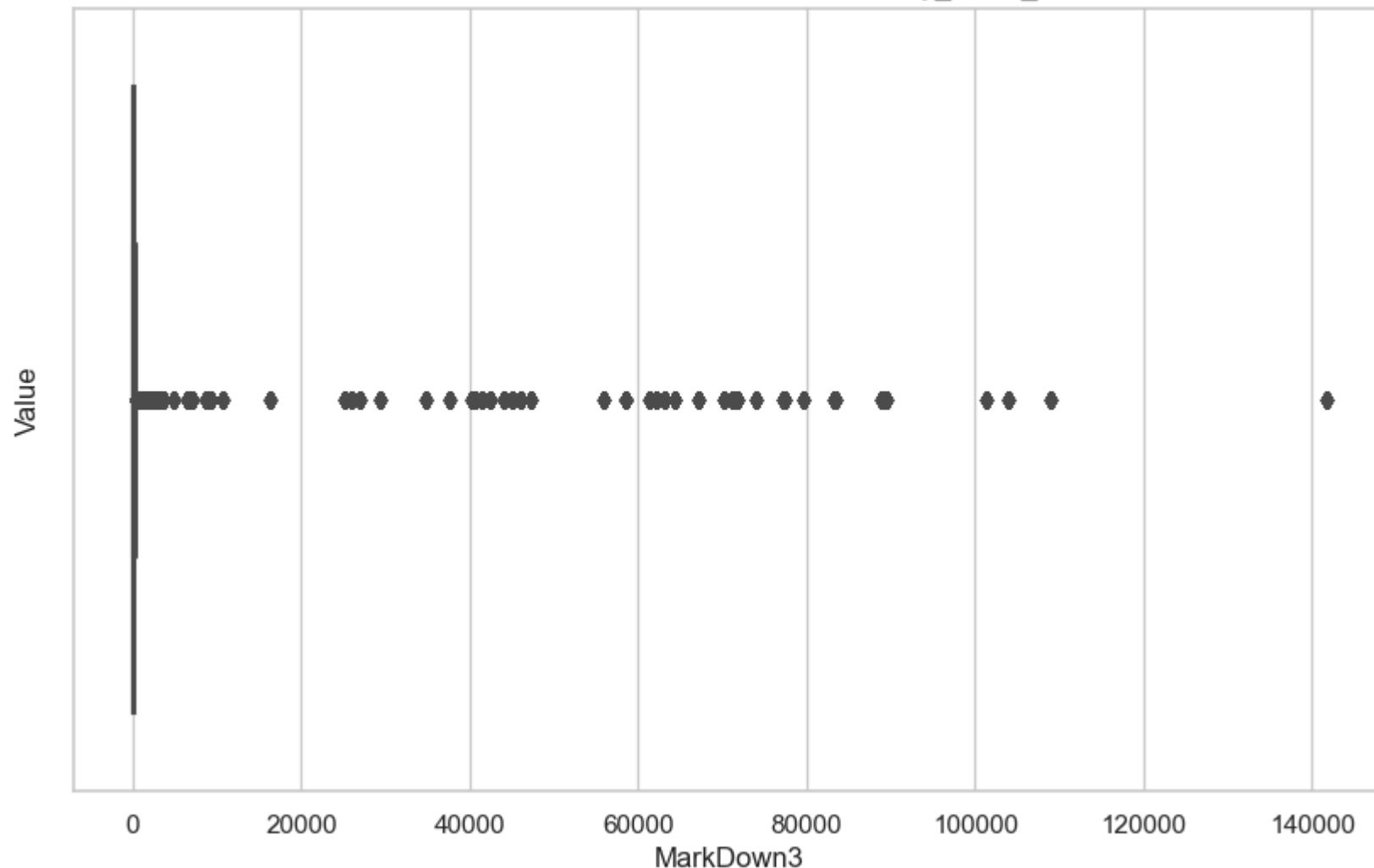


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_5w

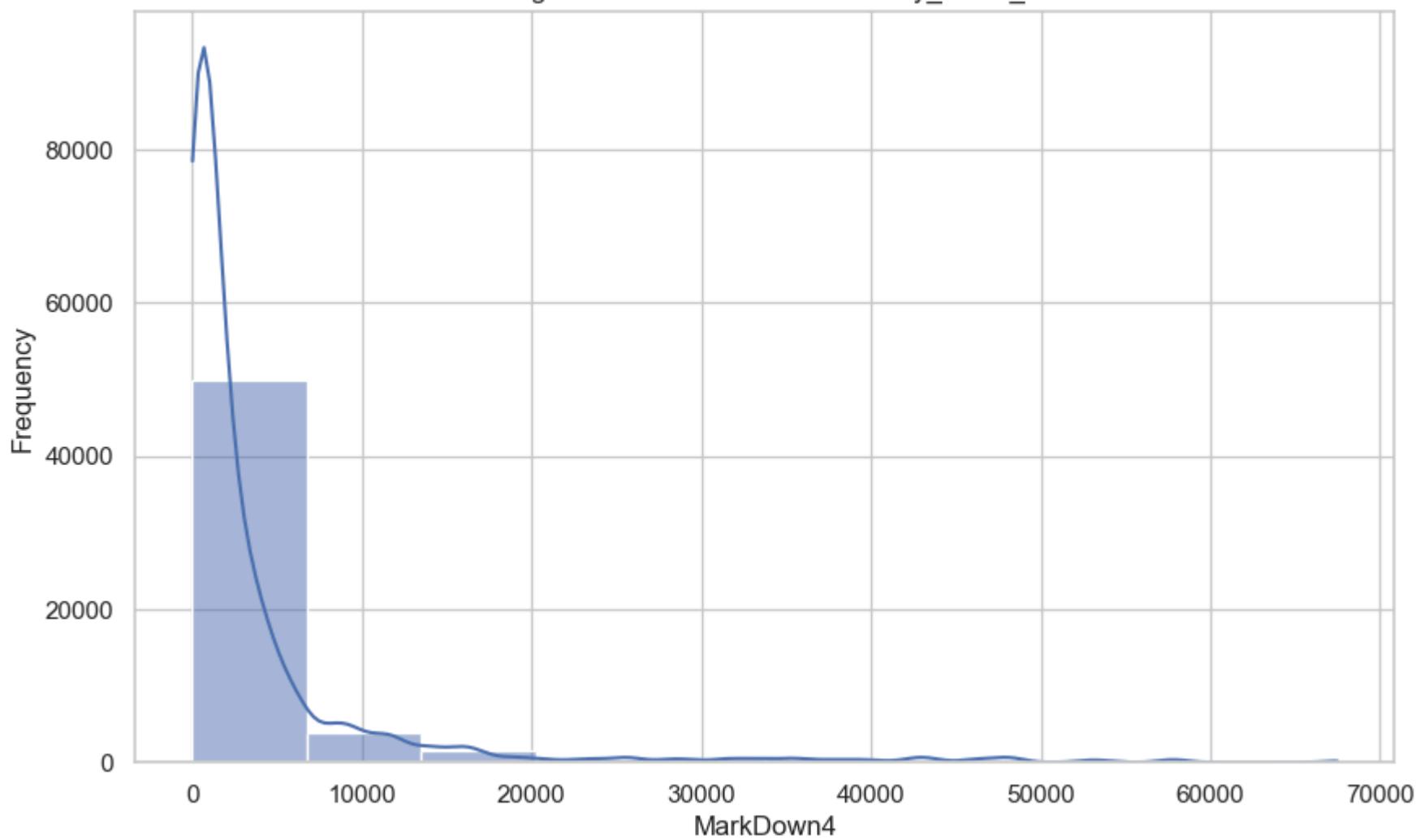


Box Plot of MarkDown3 in Data with Weekly_Sales_5w

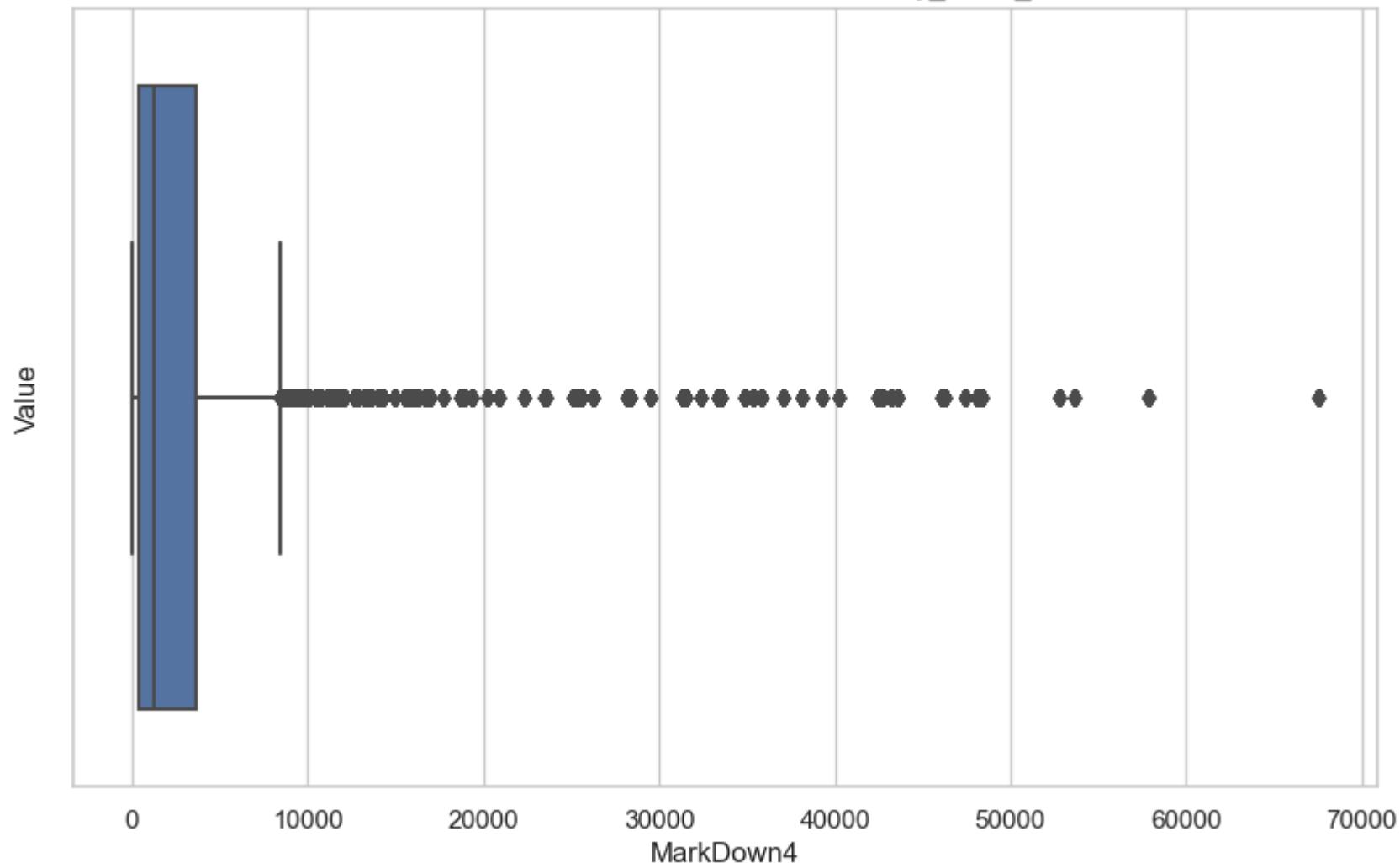


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_5w

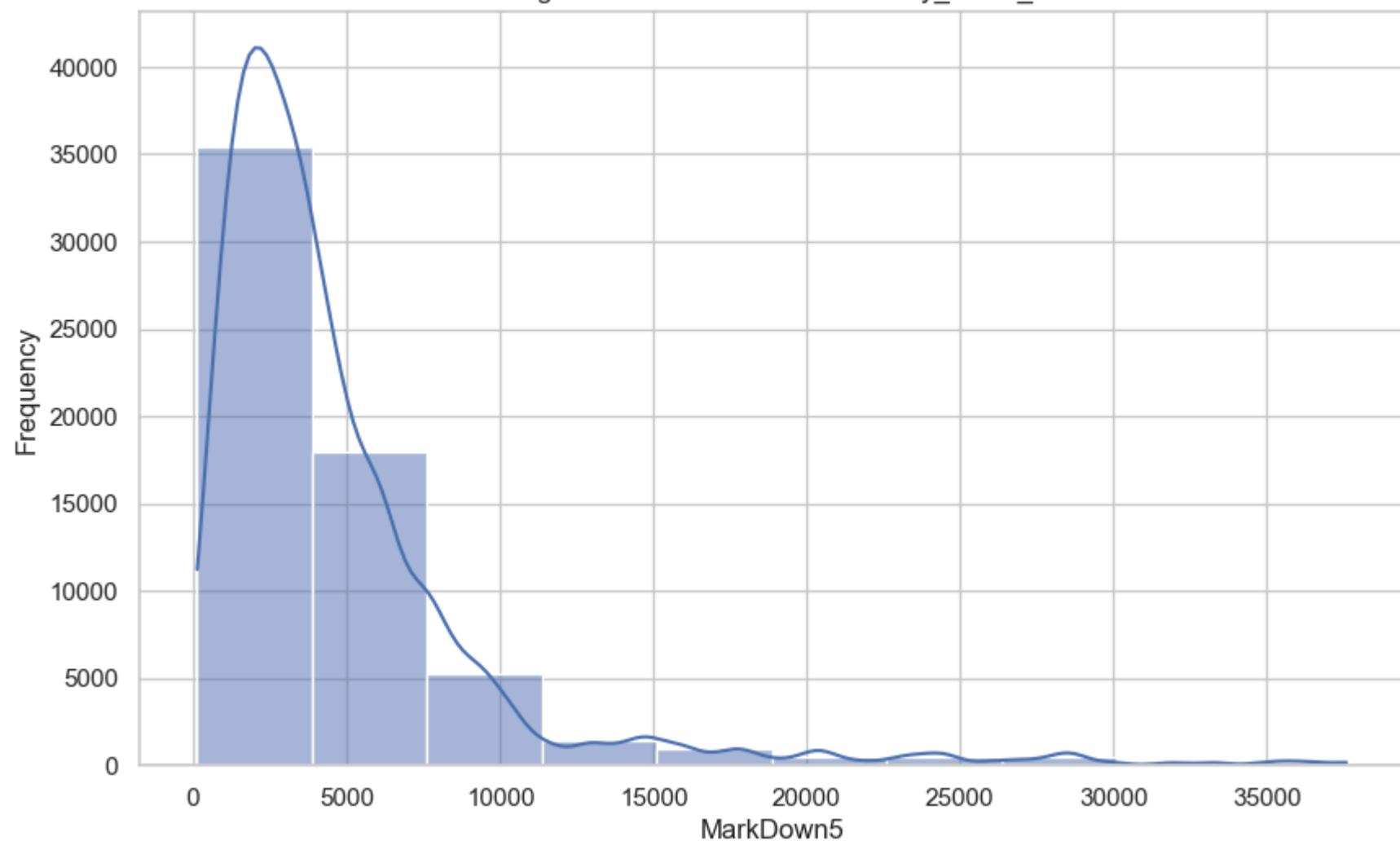


Box Plot of MarkDown4 in Data with Weekly_Sales_5w

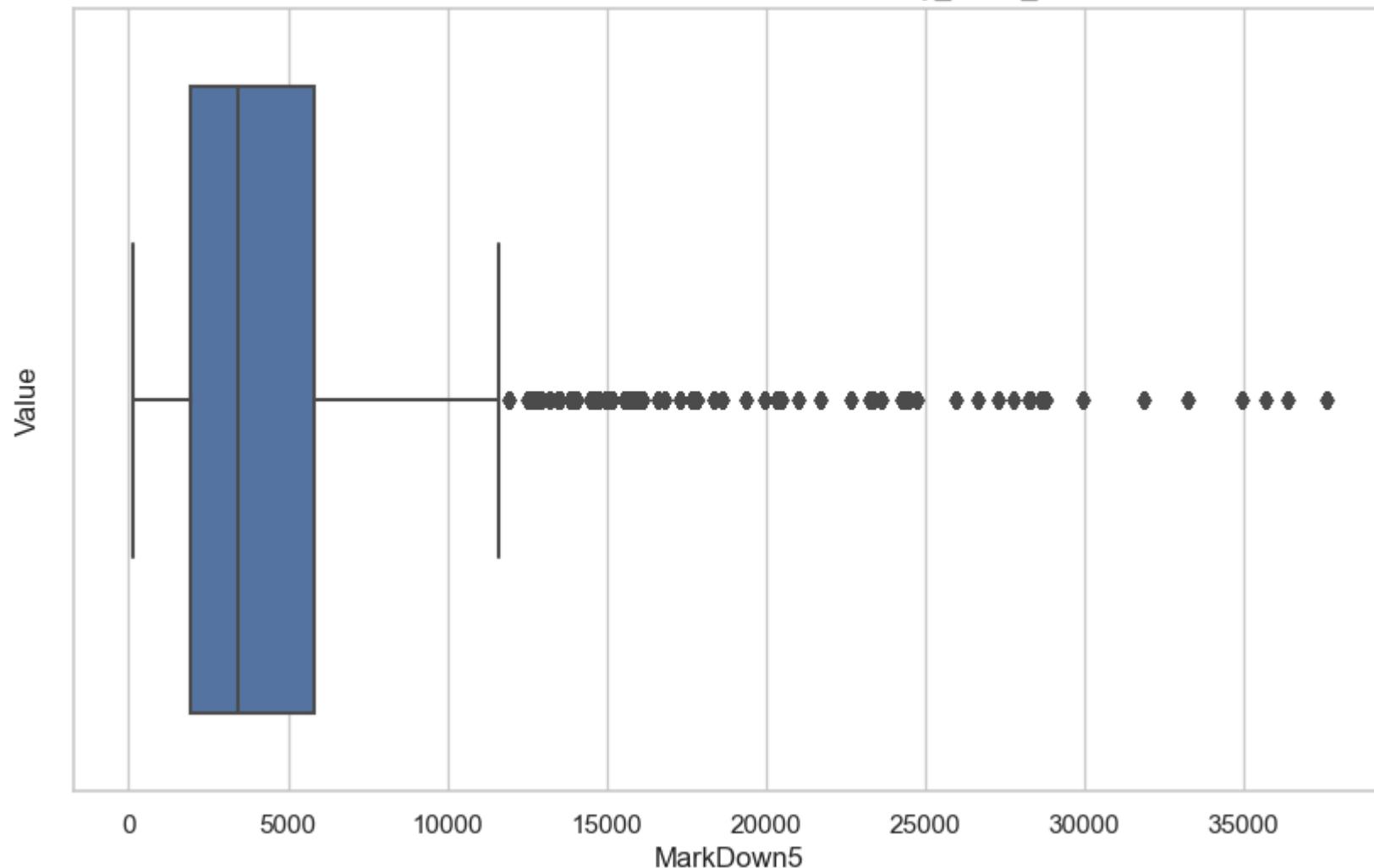


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_5w

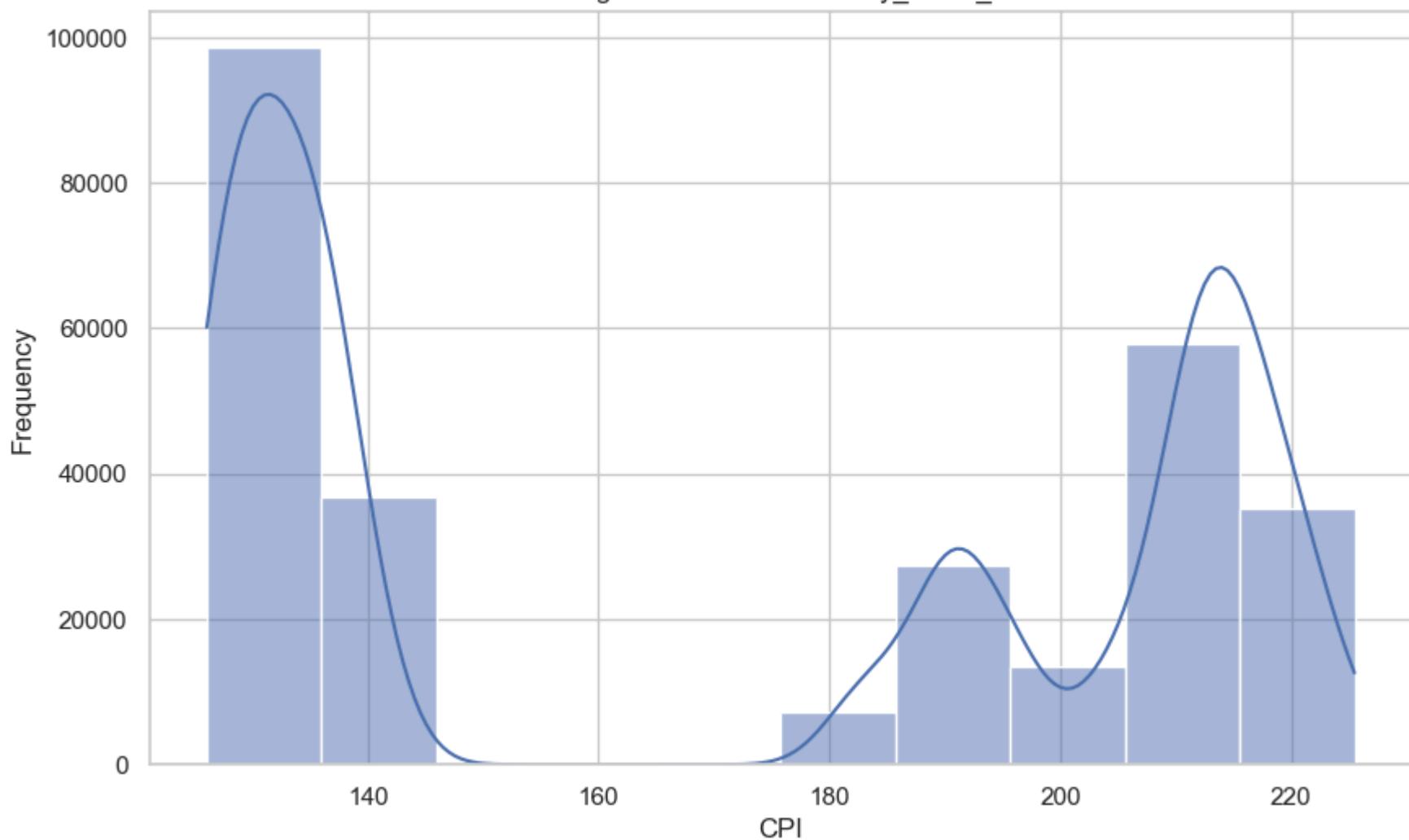


Box Plot of MarkDown5 in Data with Weekly_Sales_5w

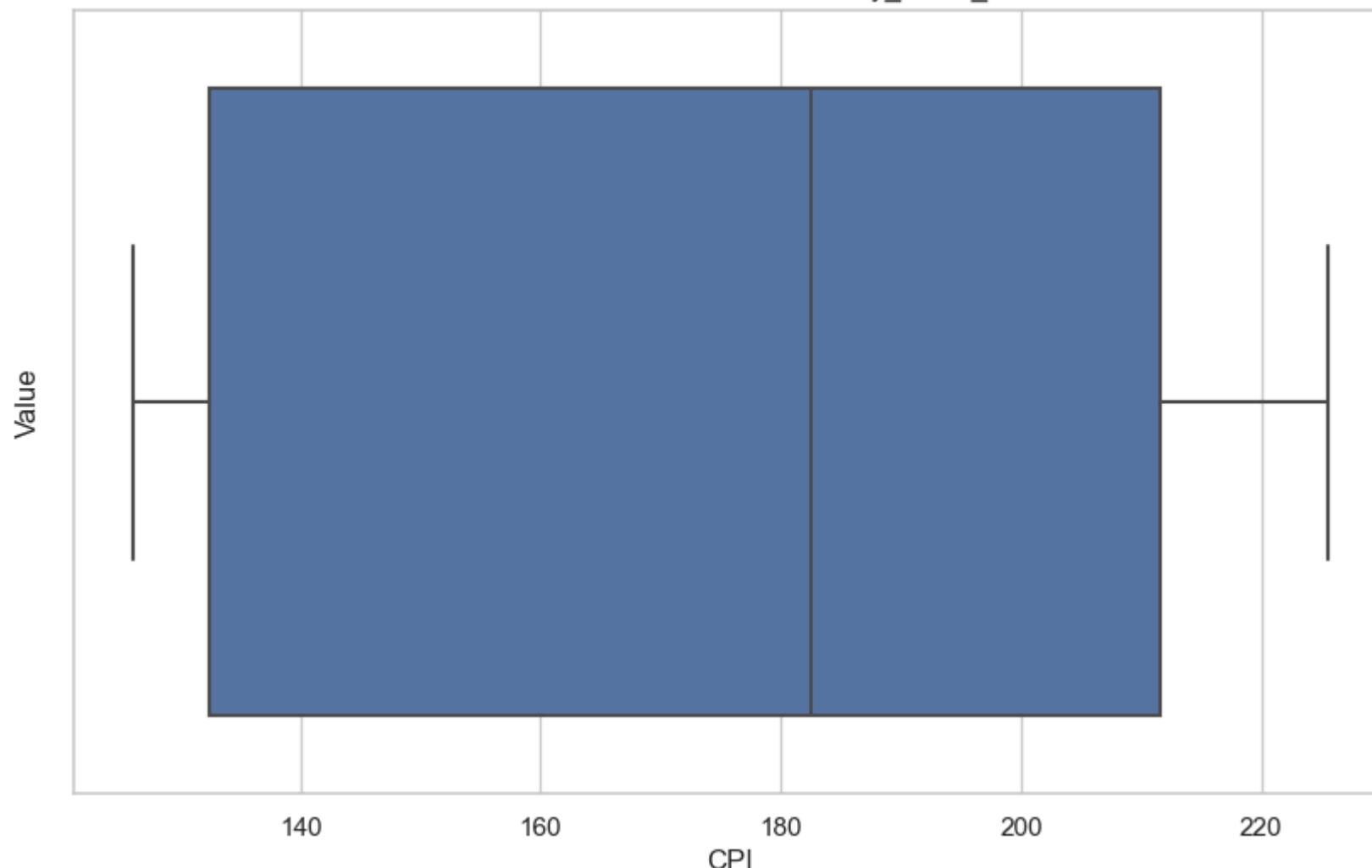


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_5w

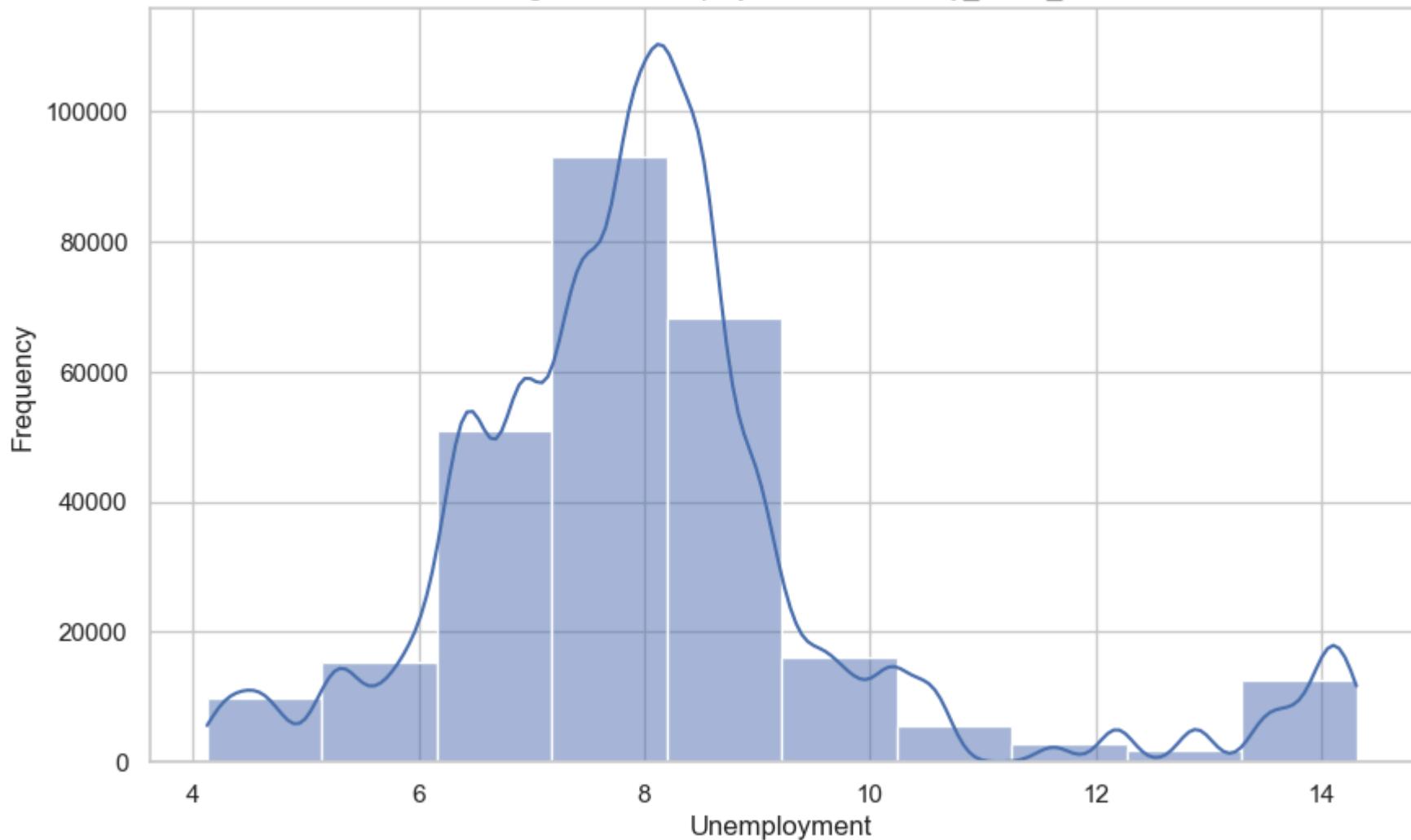


Box Plot of CPI in Data with Weekly_Sales_5w

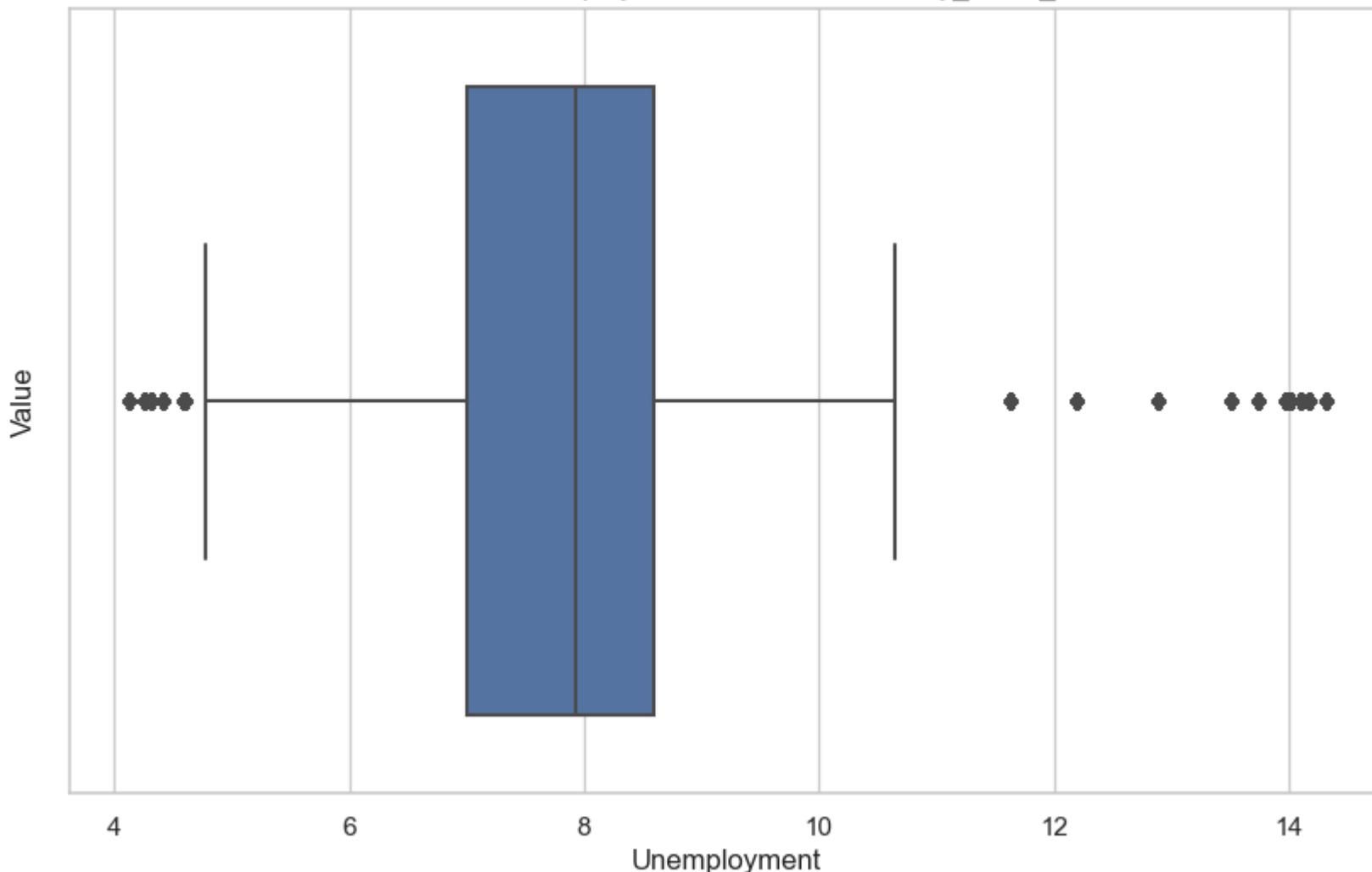


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_5w

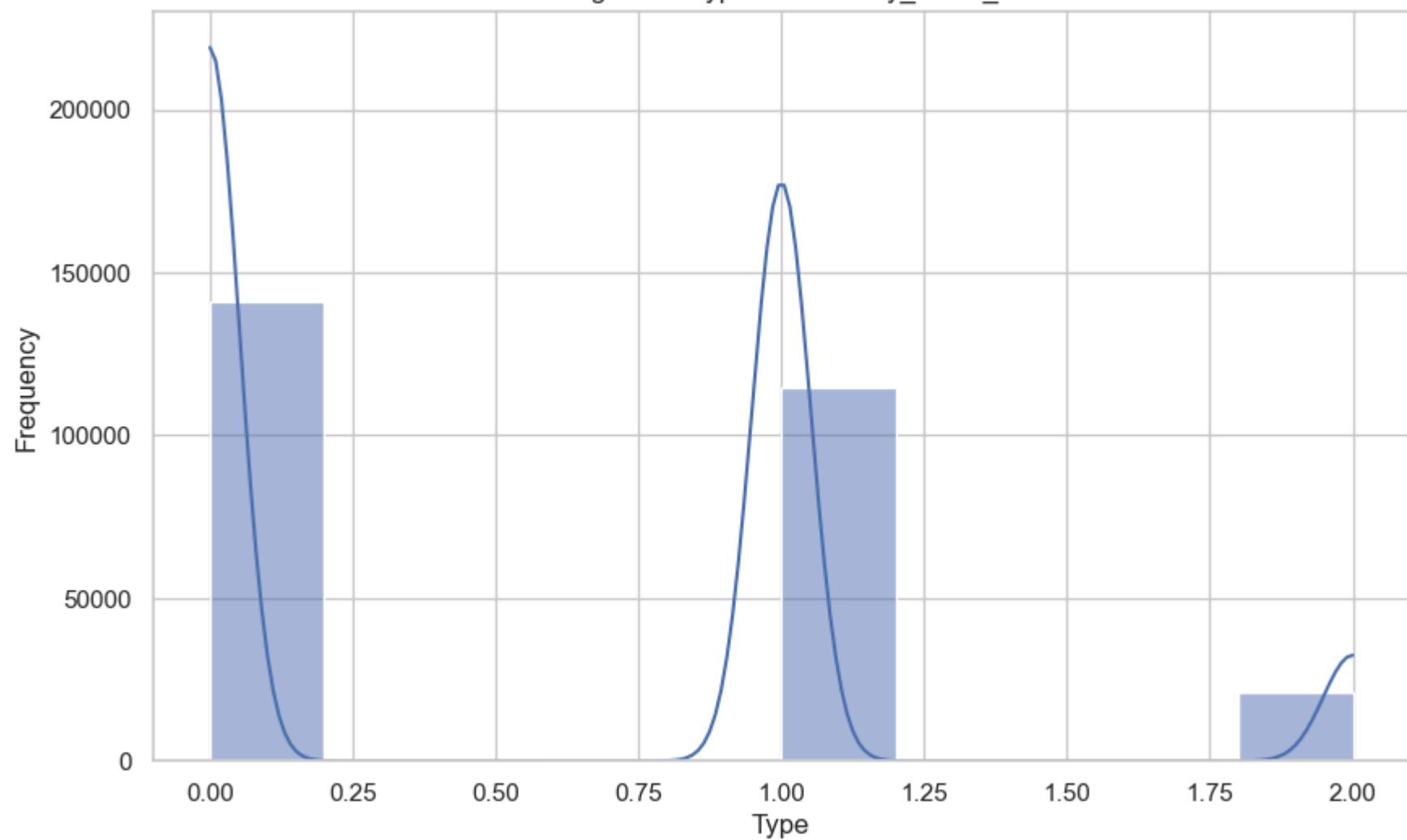


Box Plot of Unemployment in Data with Weekly_Sales_5w

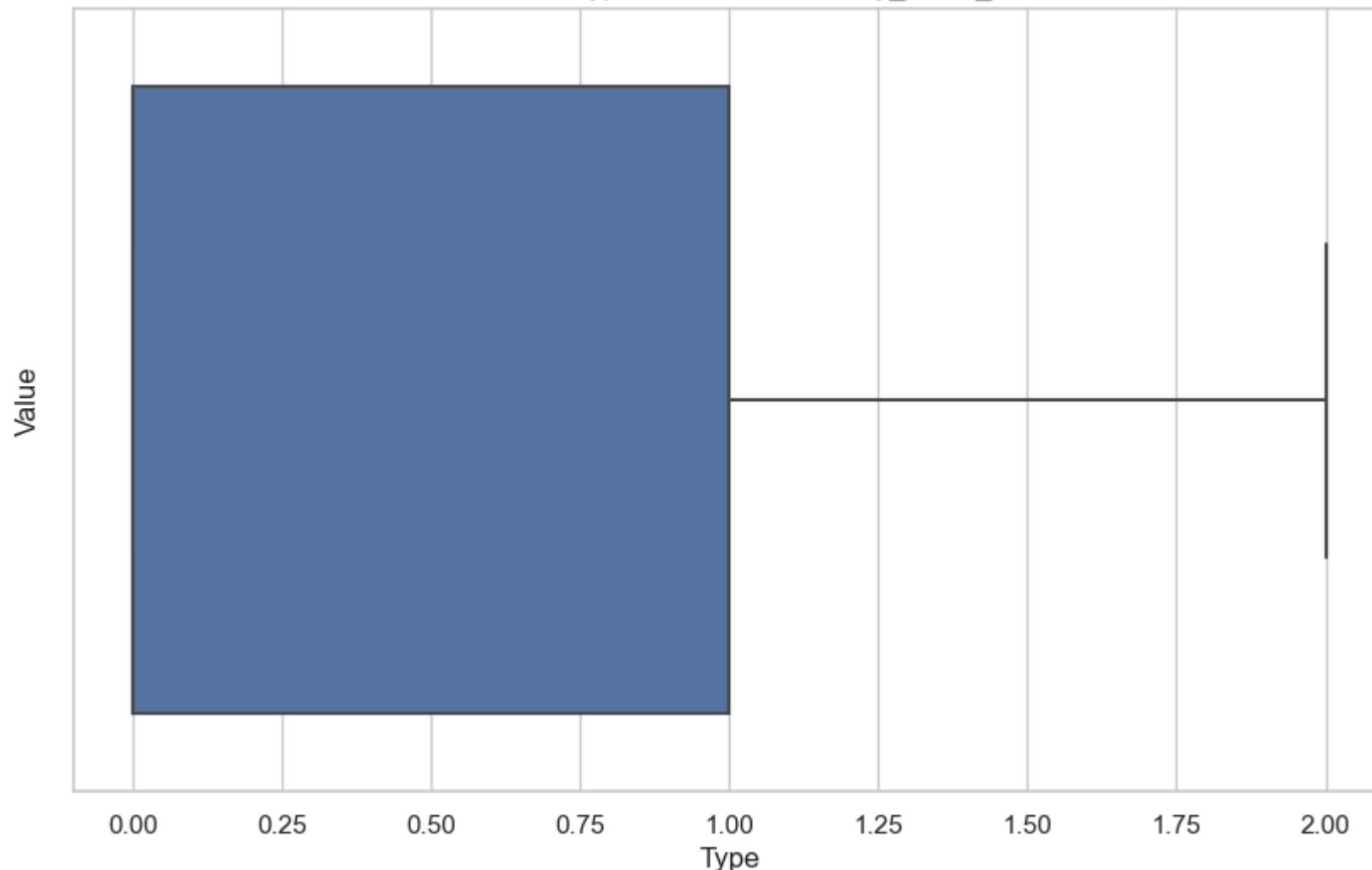


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_5w

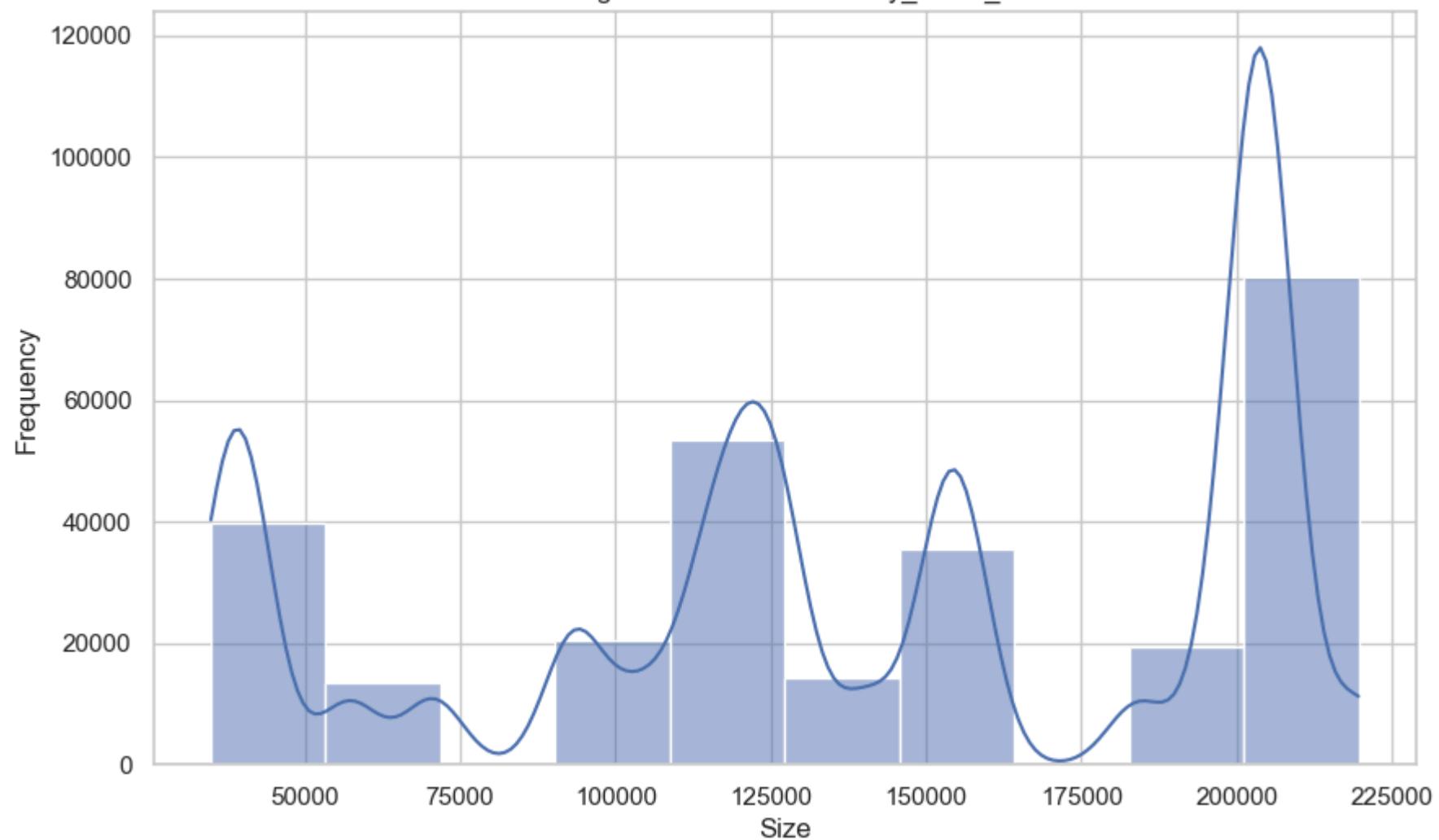


Box Plot of Type in Data with Weekly_Sales_5w

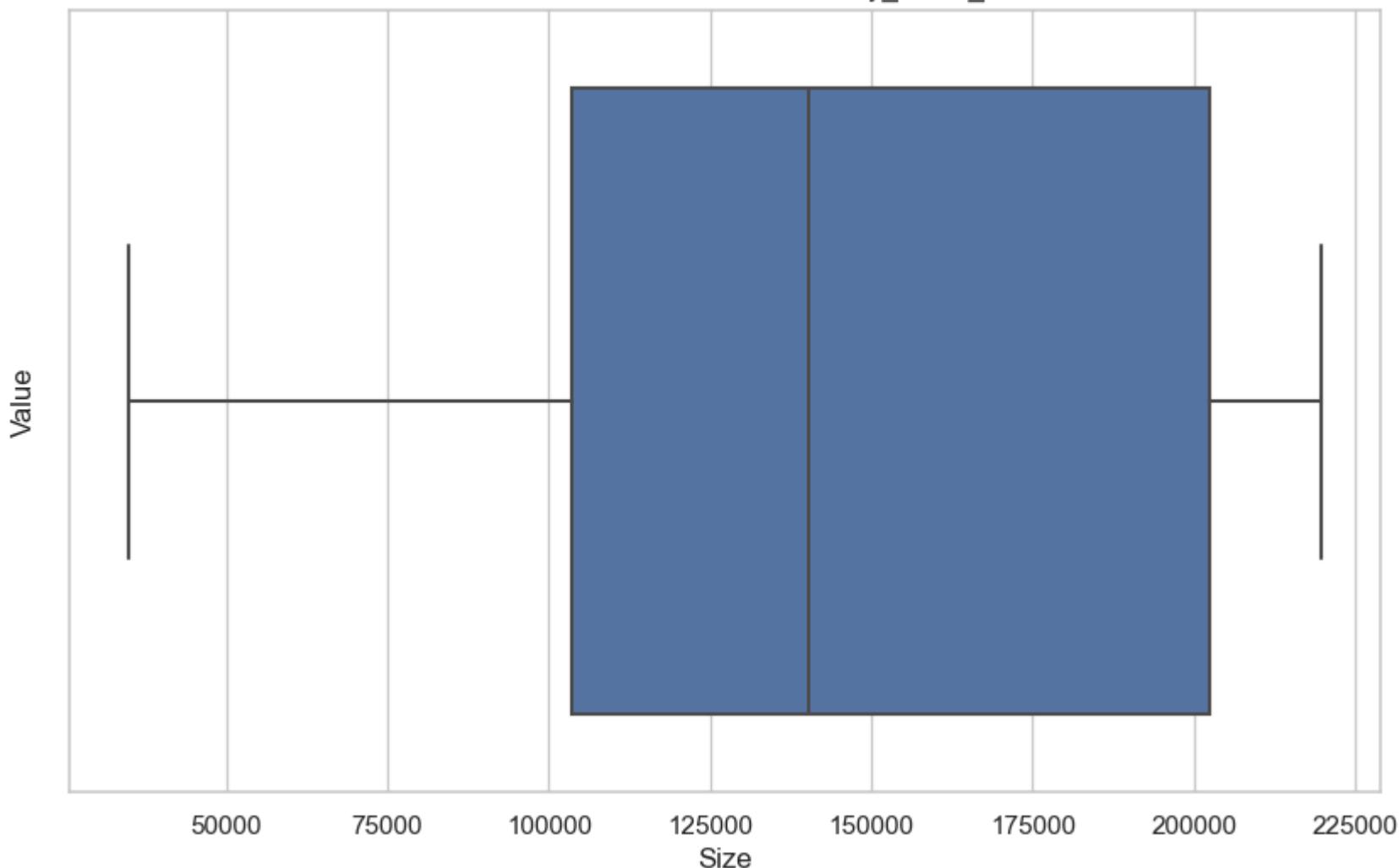


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_5w

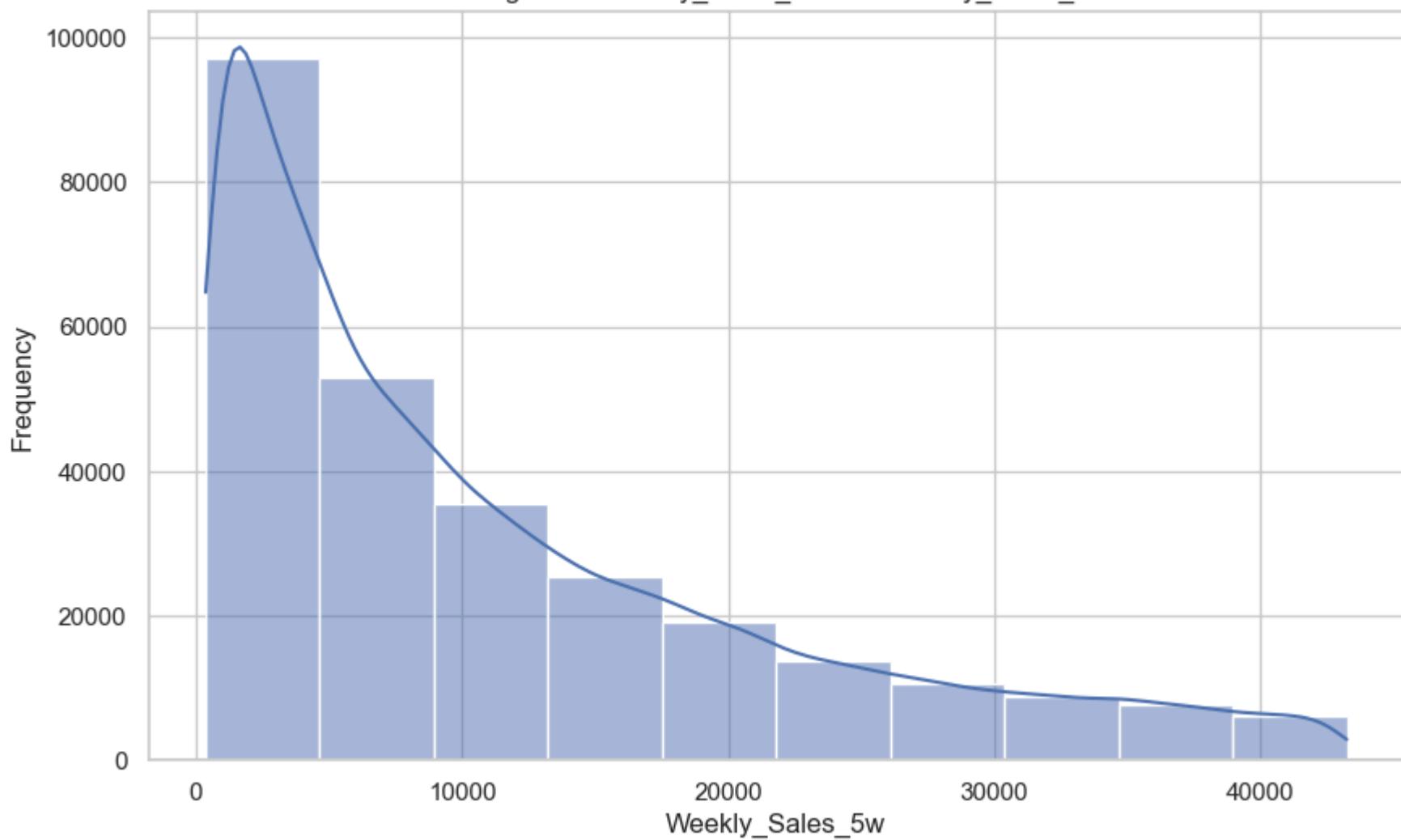


Box Plot of Size in Data with Weekly_Sales_5w

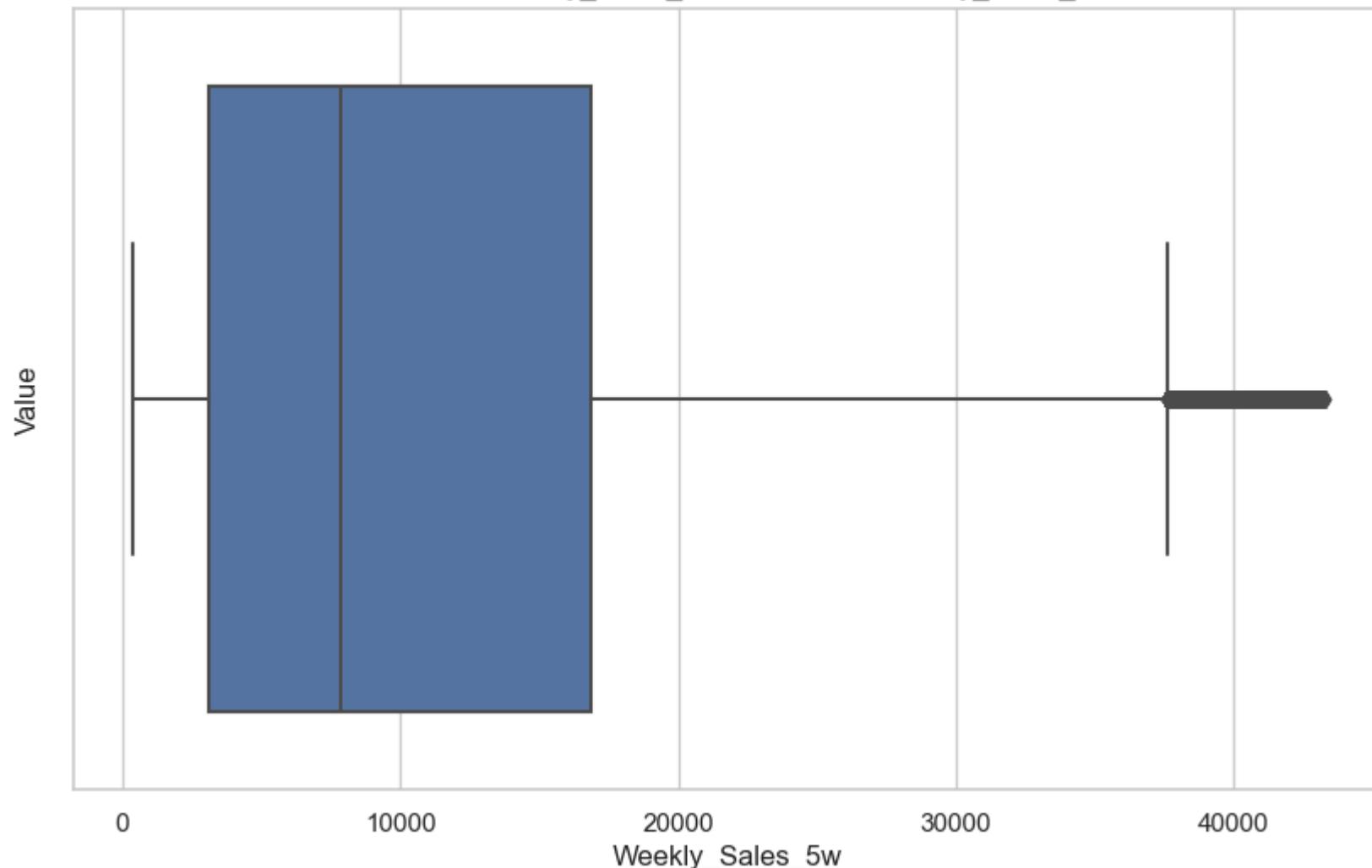


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_5w with Weekly_Sales_5w

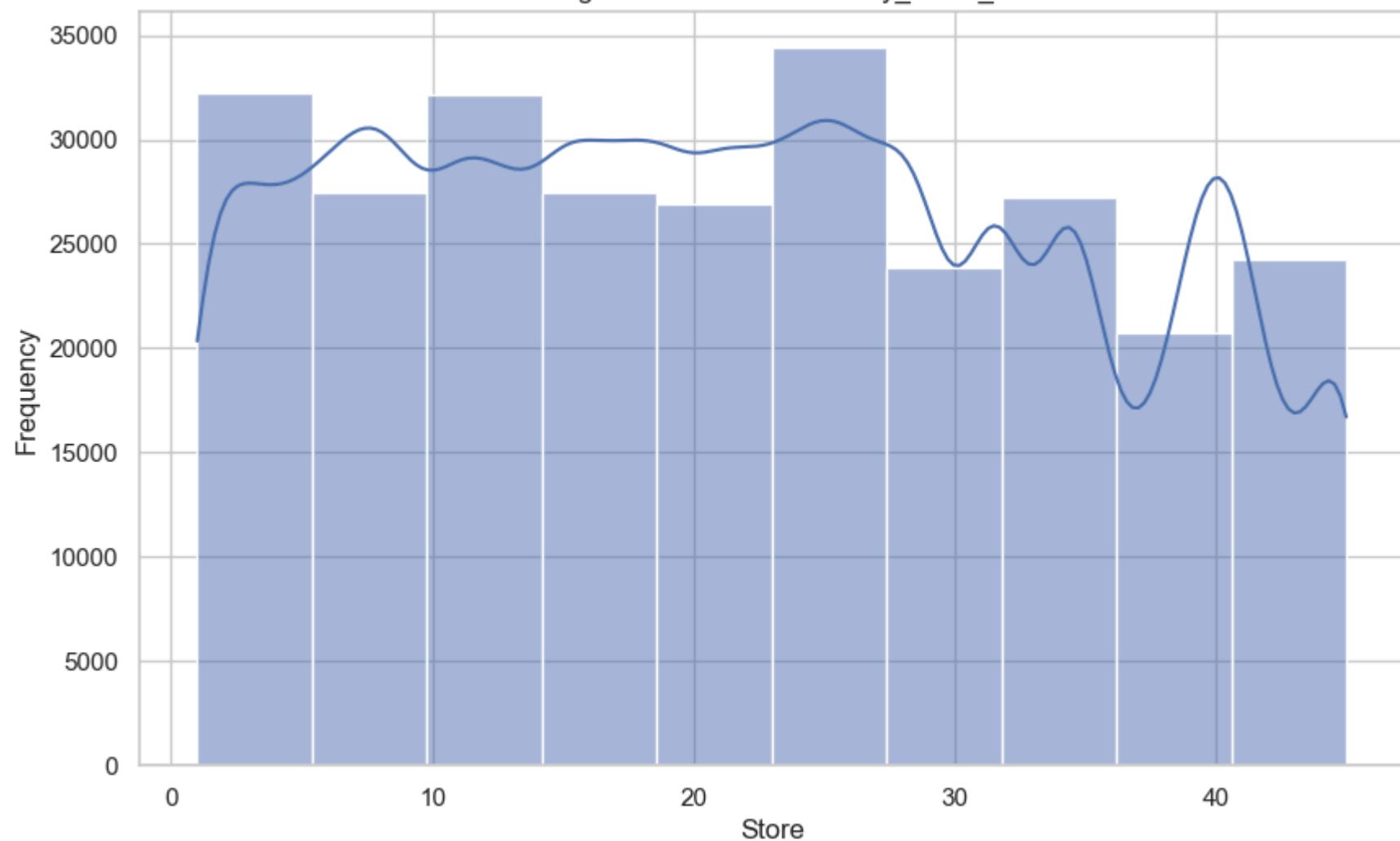


Box Plot of Weekly_Sales_5w in Data with Weekly_Sales_5w

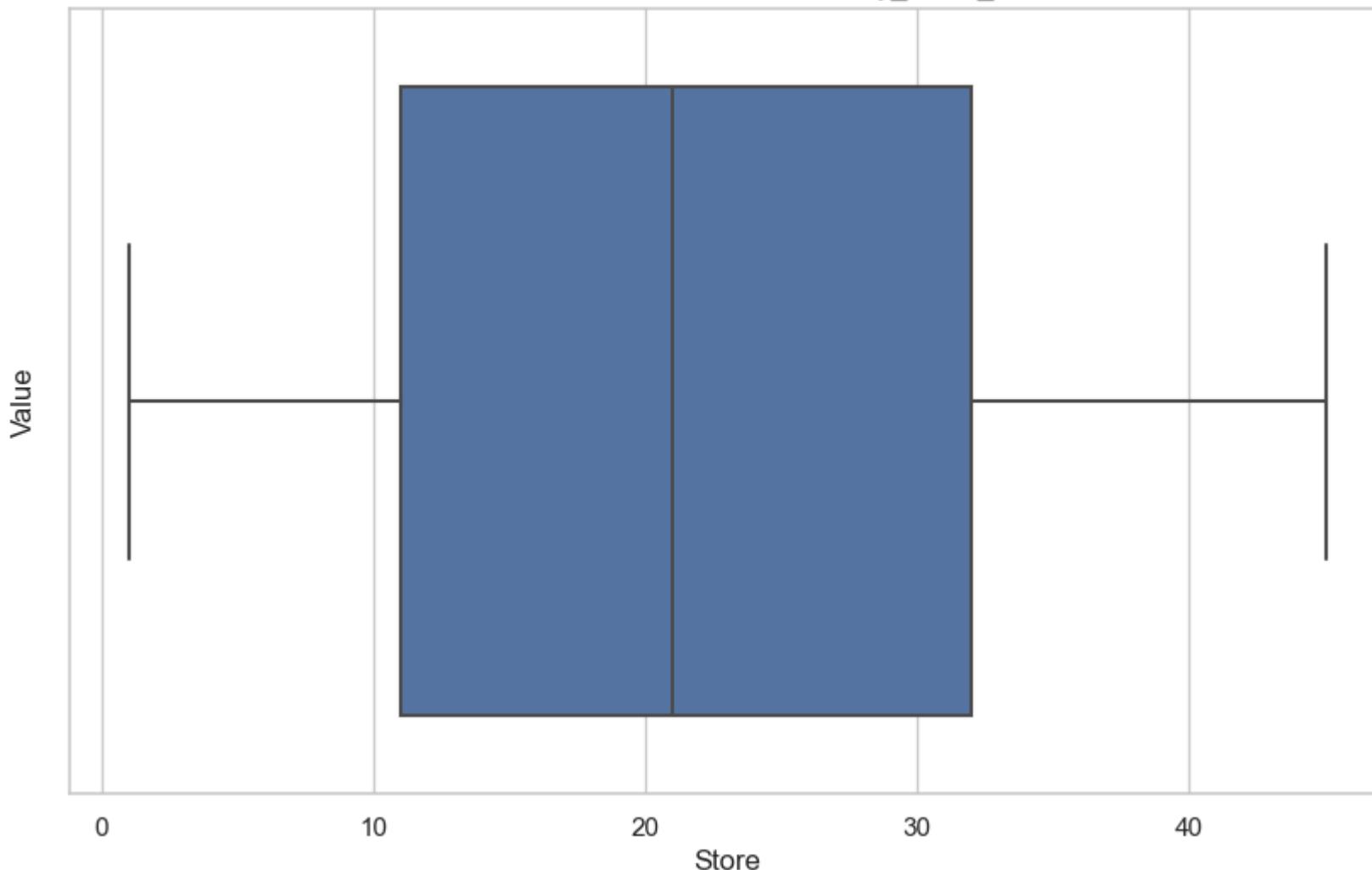


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_6w

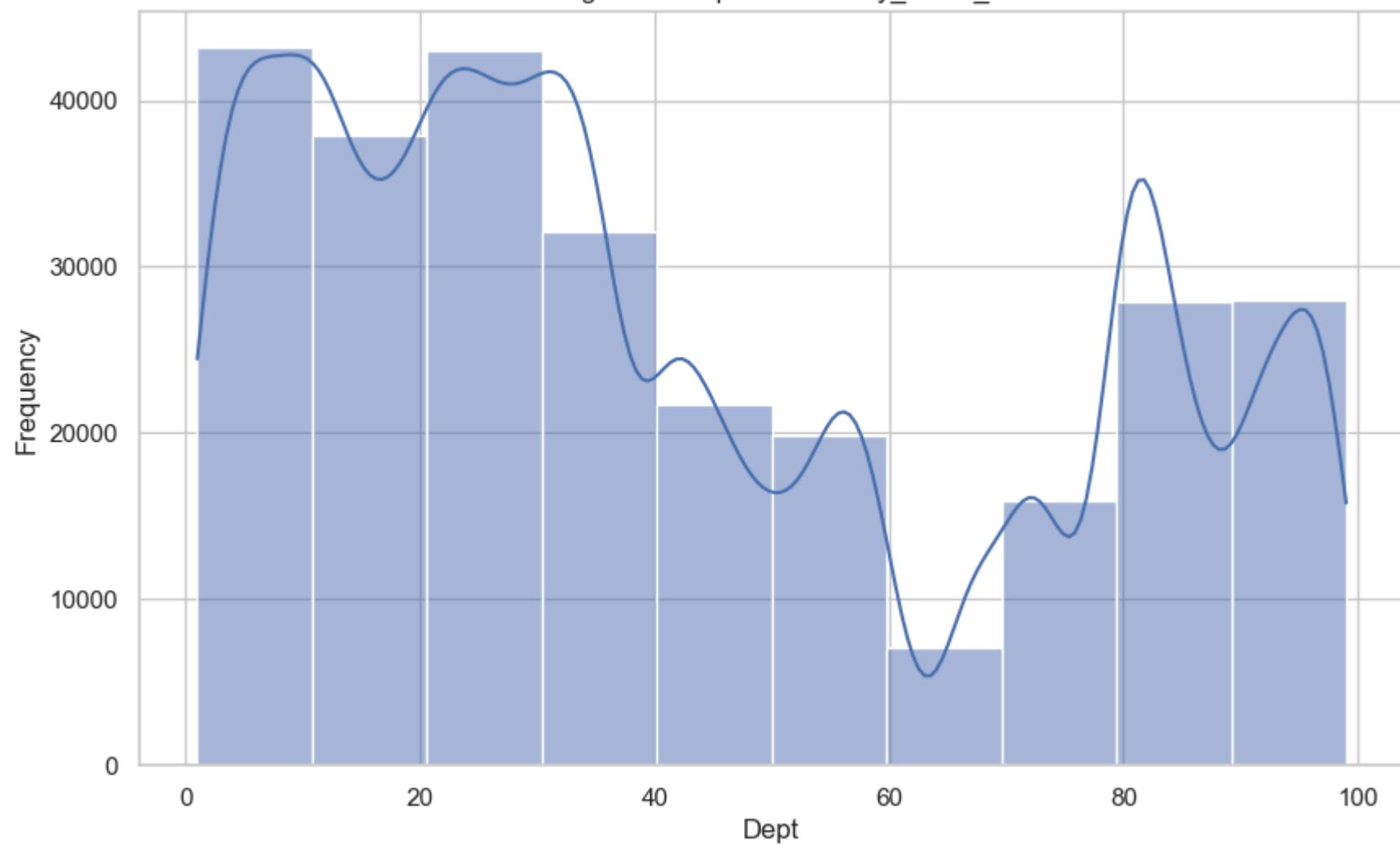


Box Plot of Store in Data with Weekly_Sales_6w

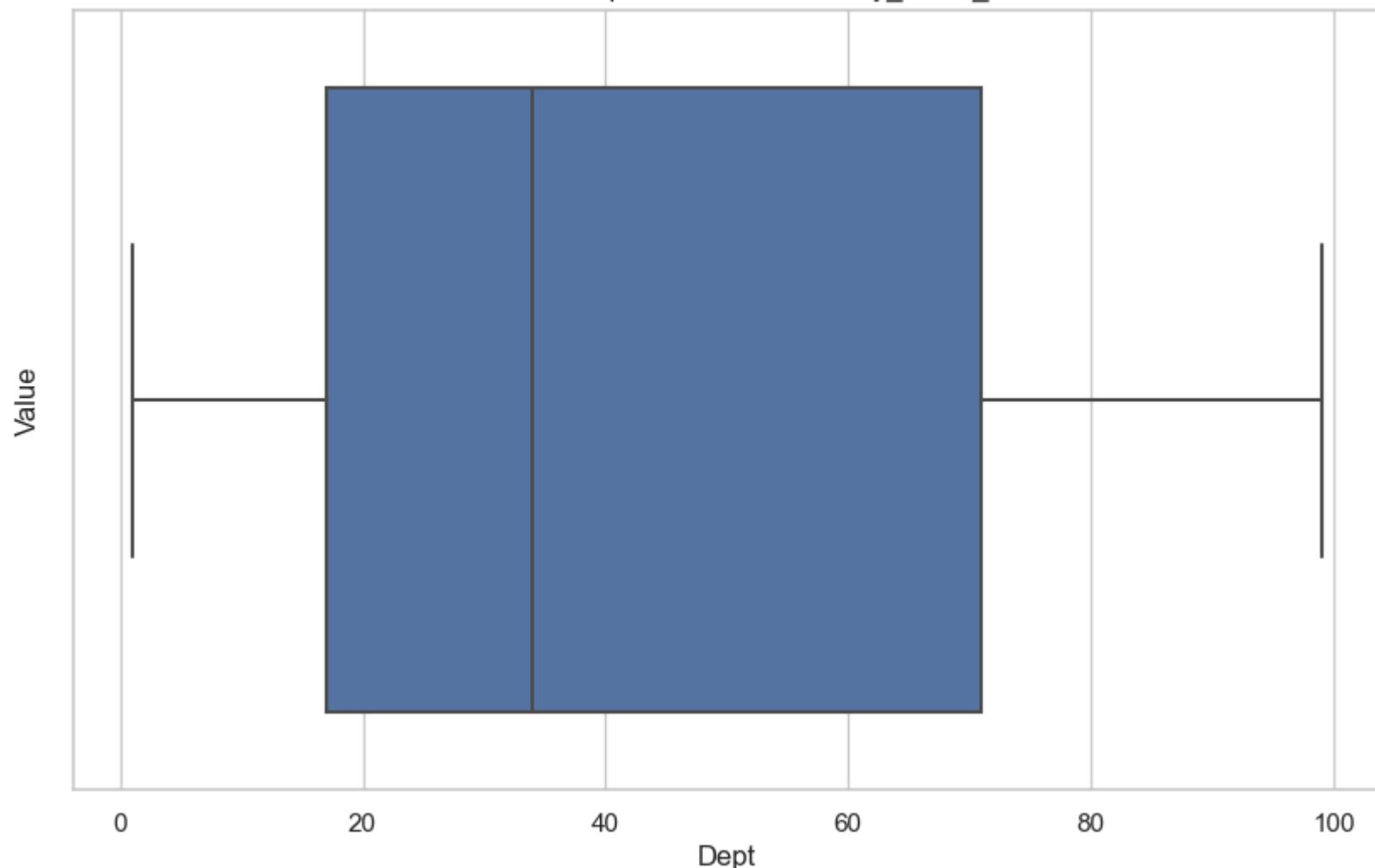


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_6w

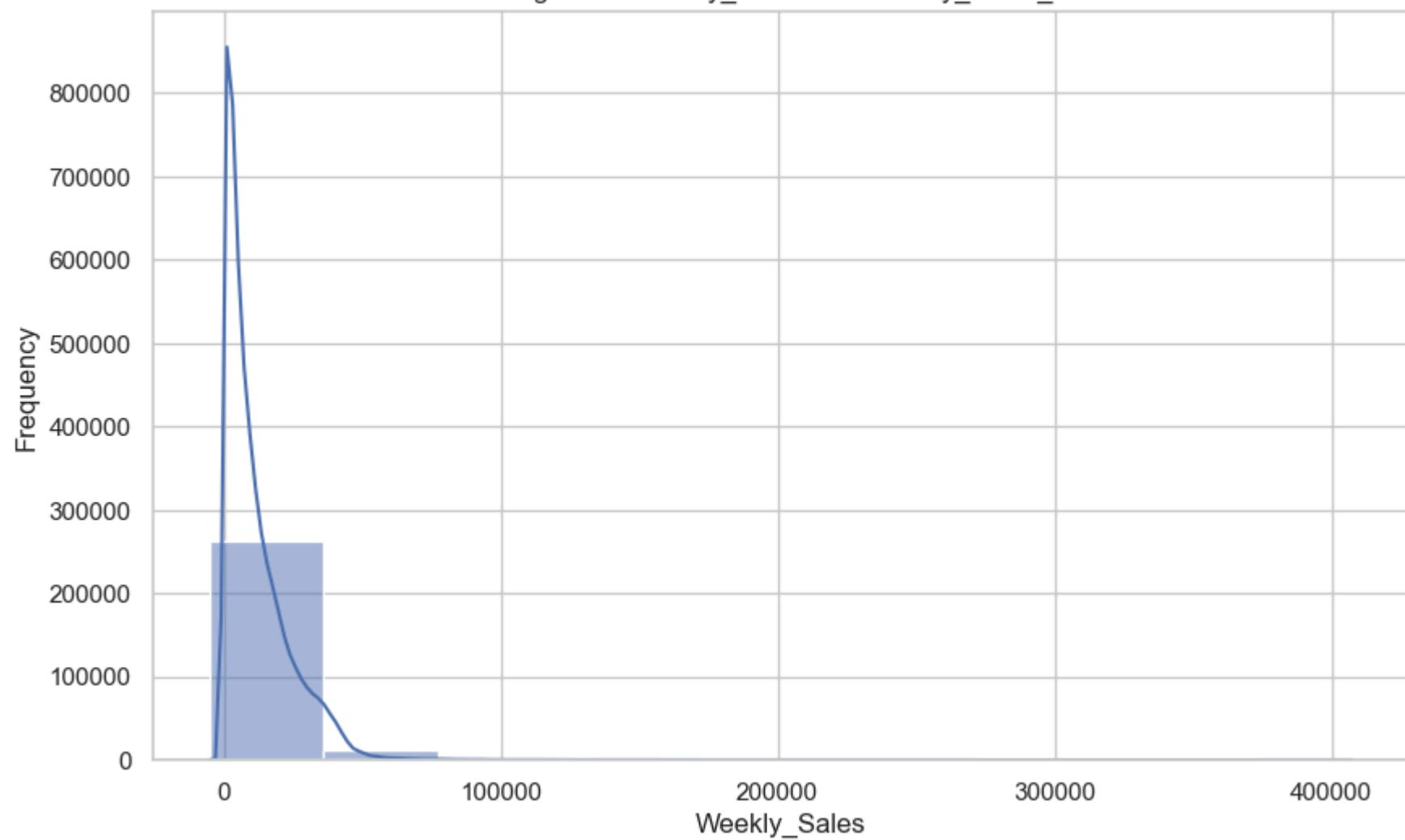


Box Plot of Dept in Data with Weekly_Sales_6w

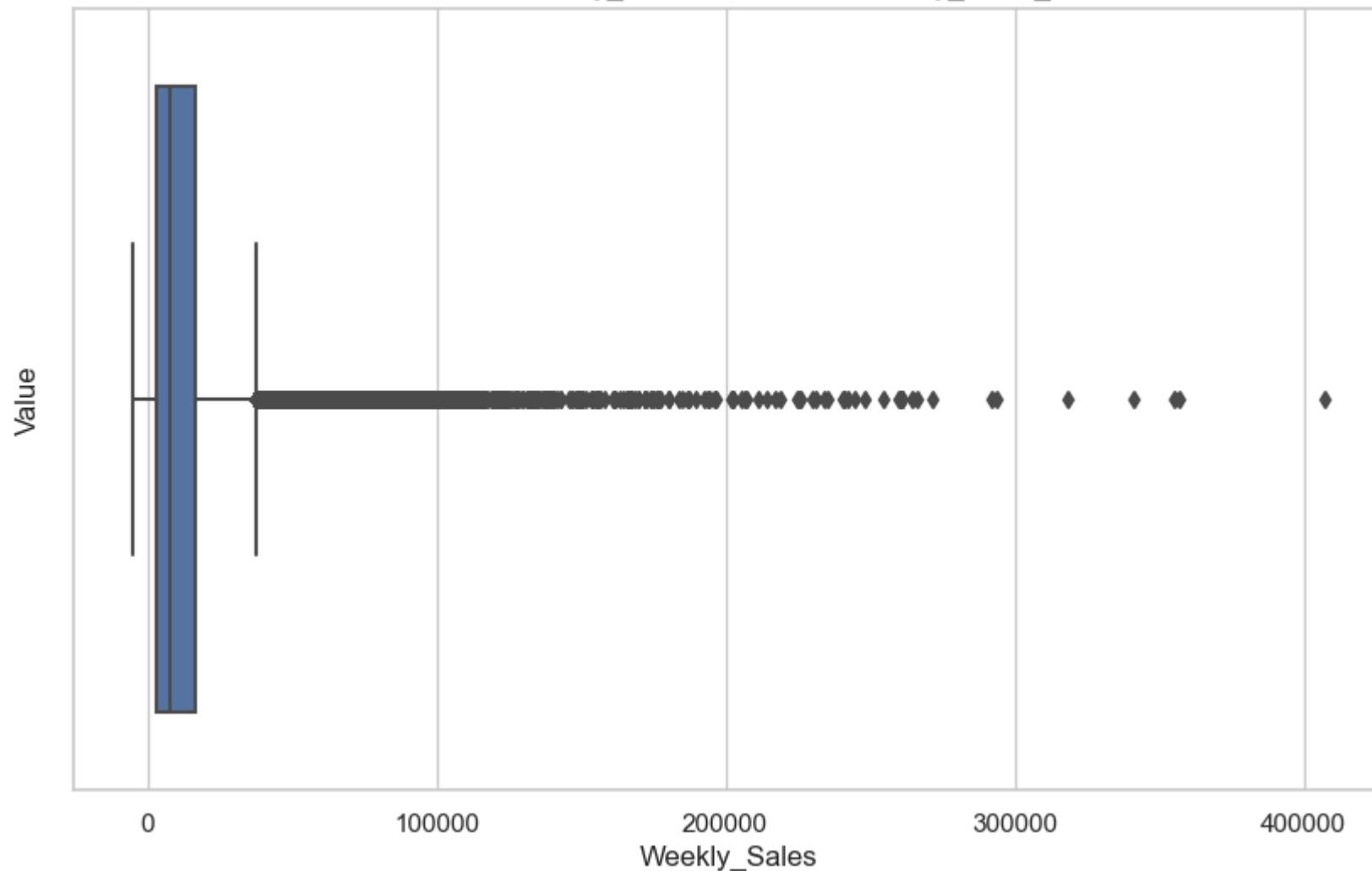


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_6w

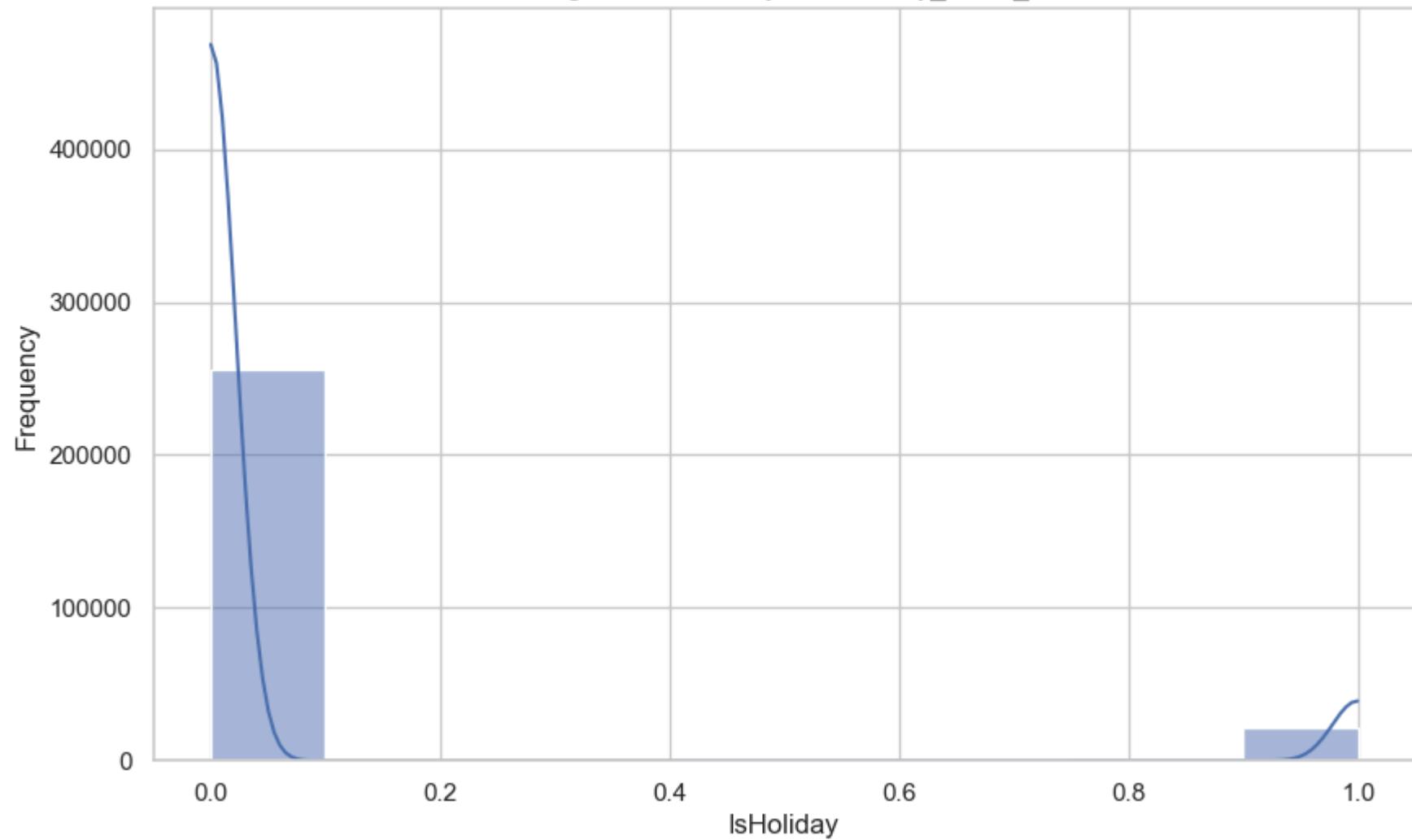


Box Plot of Weekly_Sales in Data with Weekly_Sales_6w

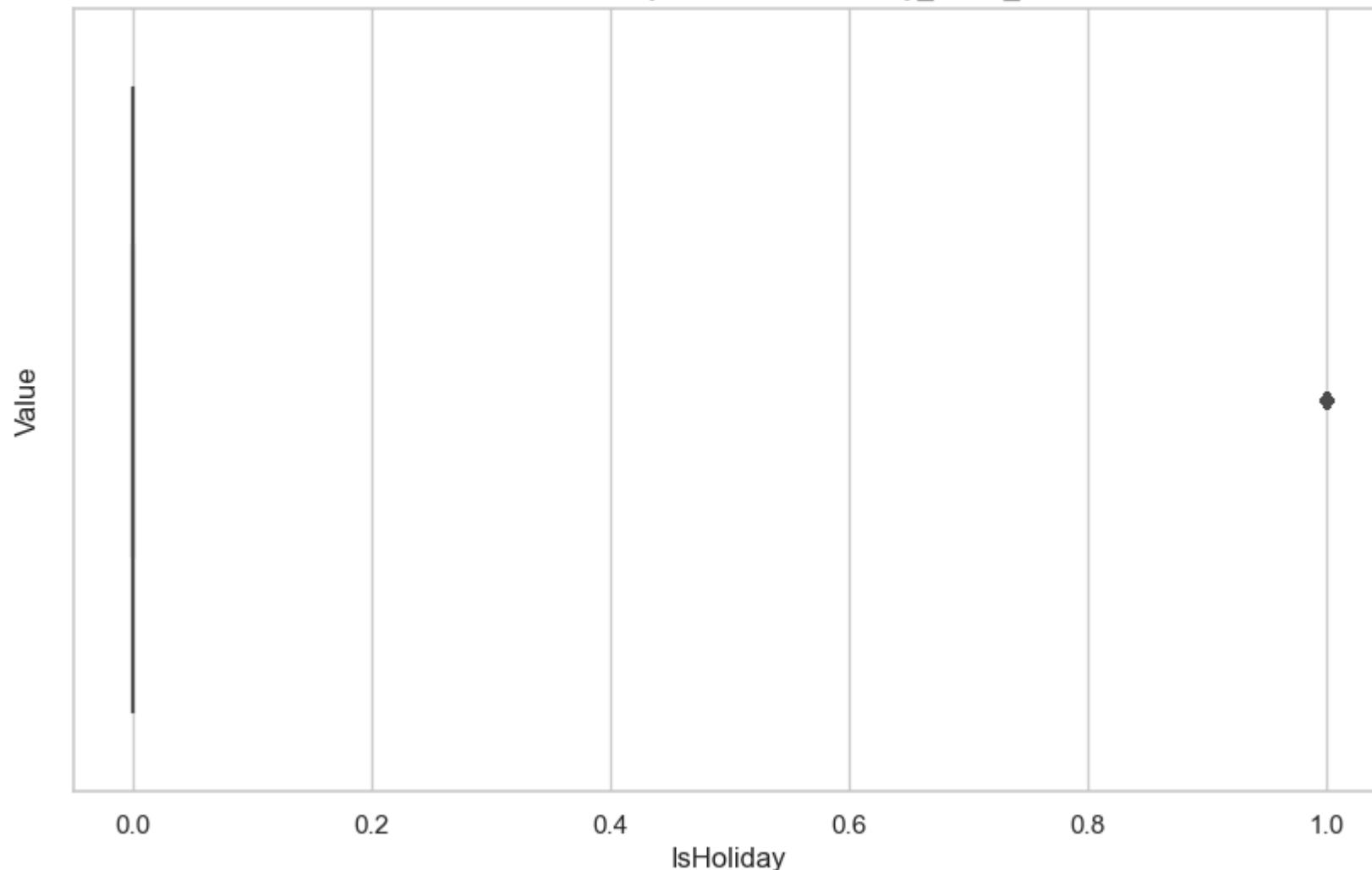


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_6w

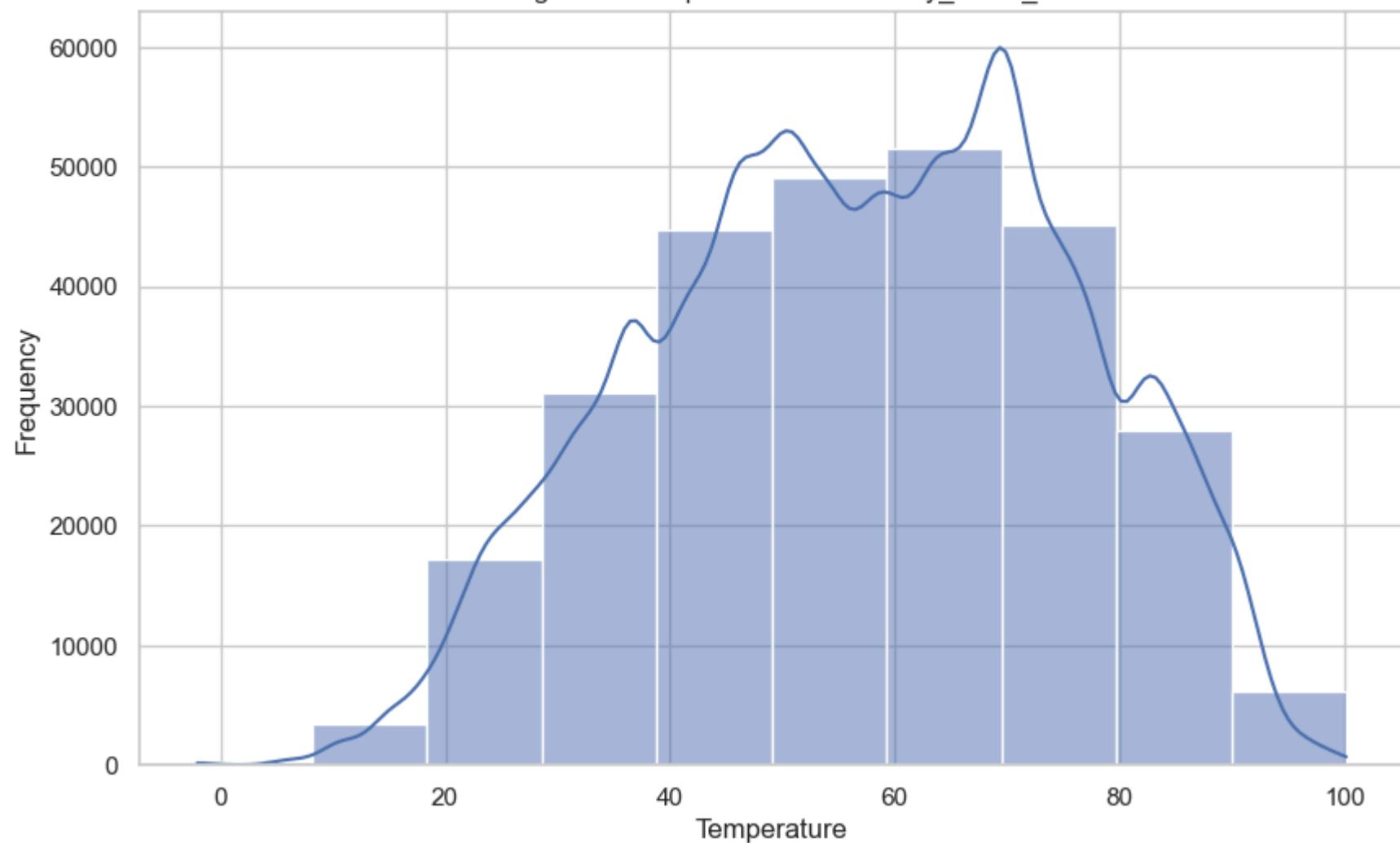


Box Plot of IsHoliday in Data with Weekly_Sales_6w

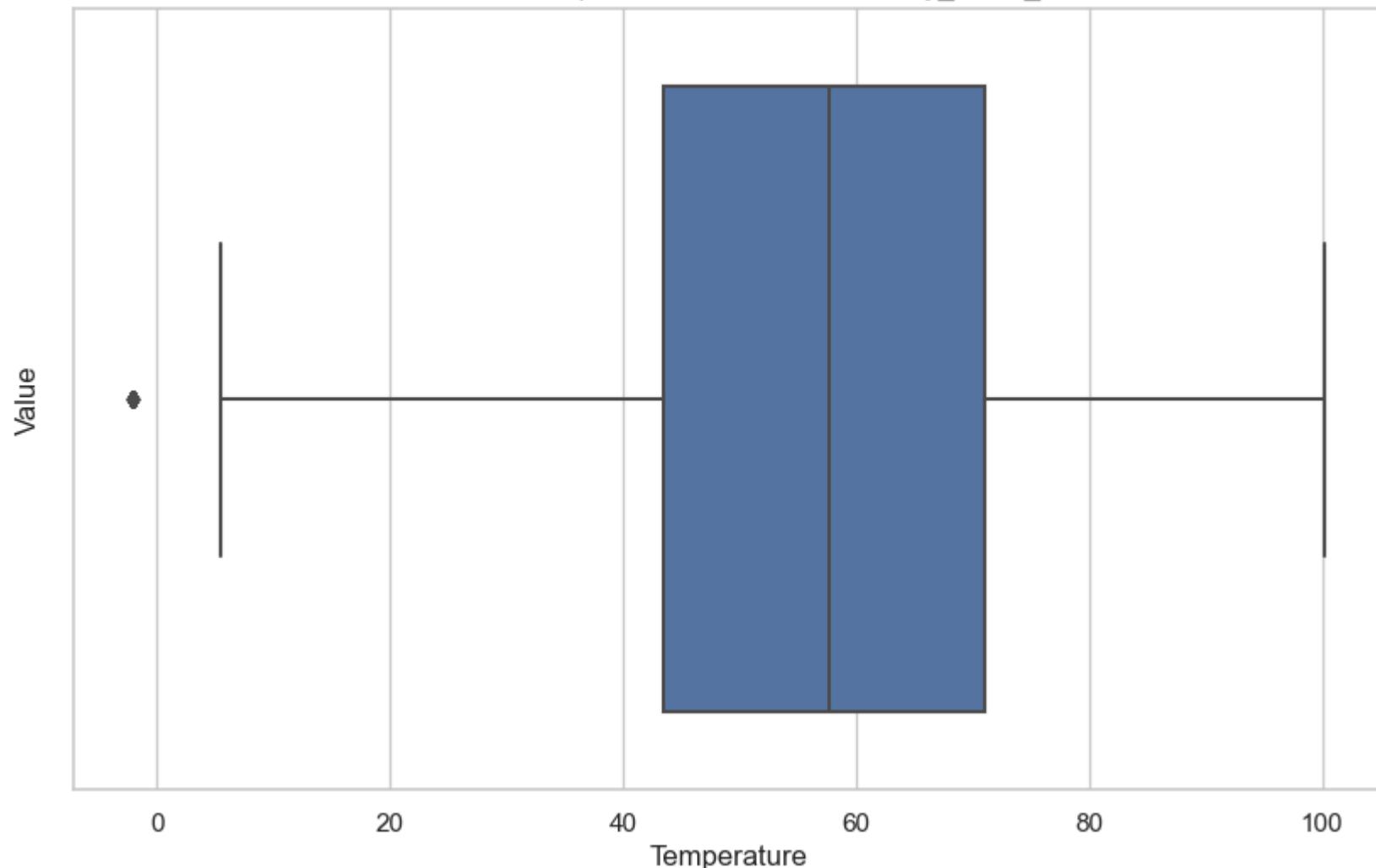


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_6w

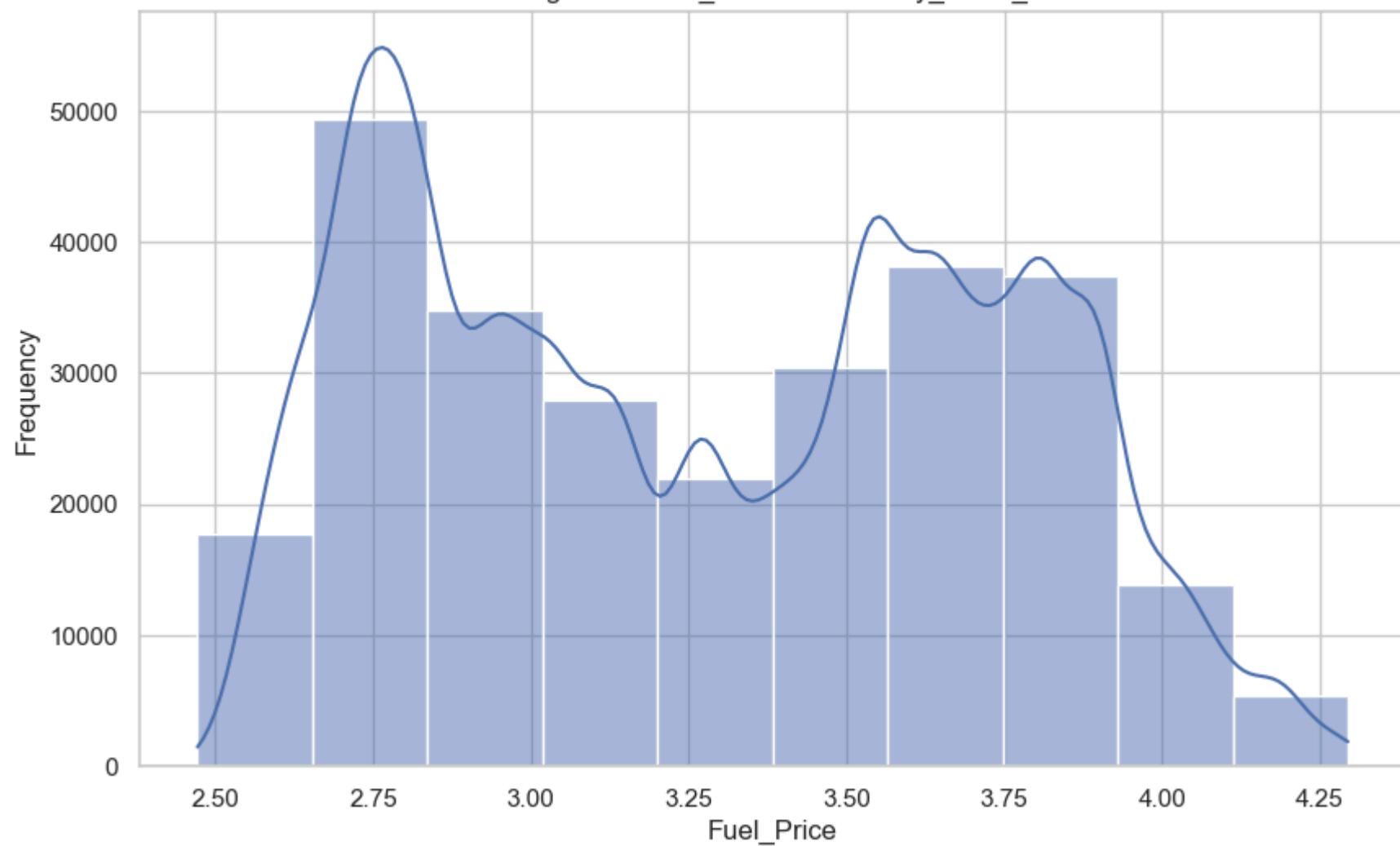


Box Plot of Temperature in Data with Weekly_Sales_6w

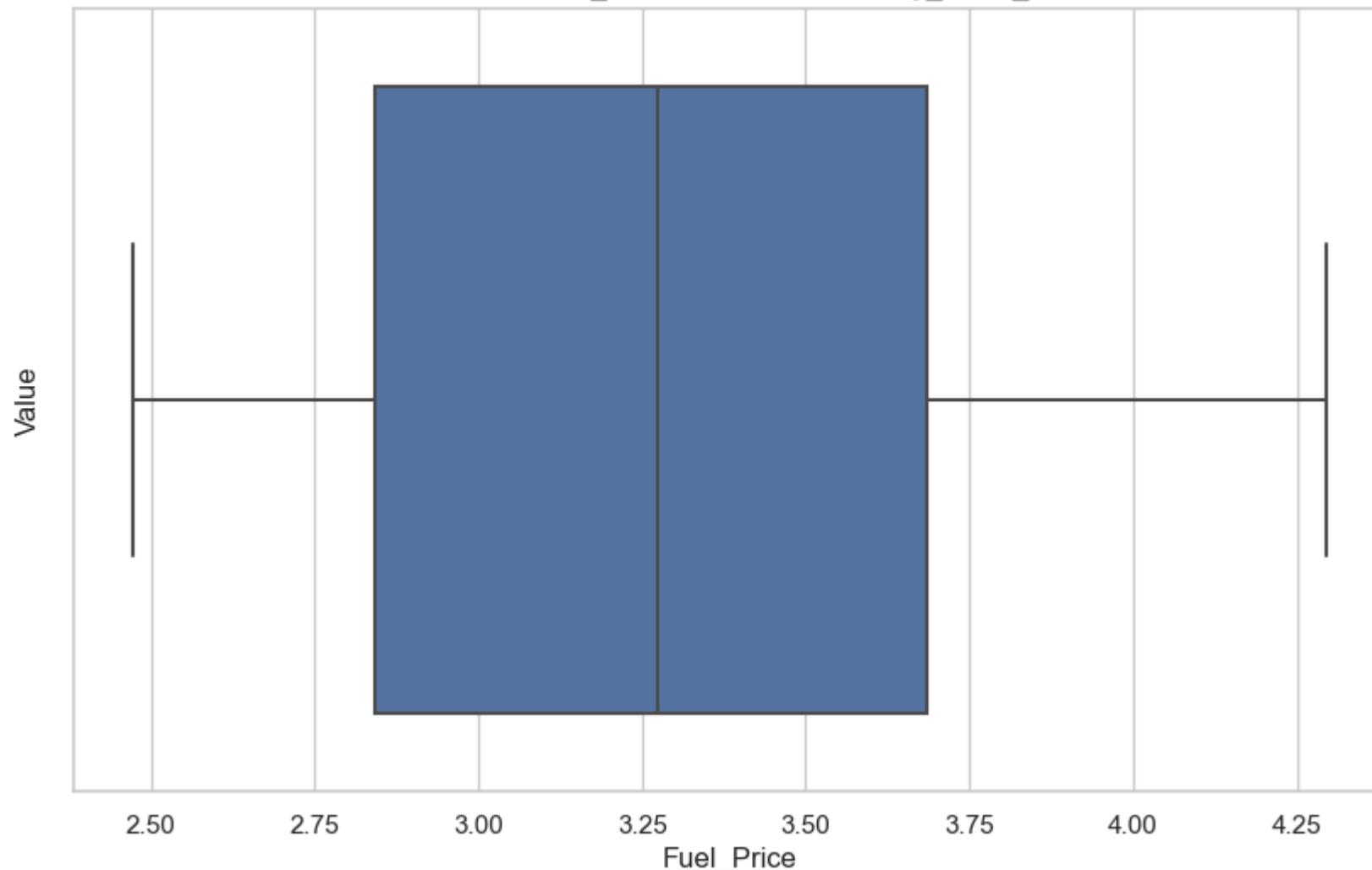


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

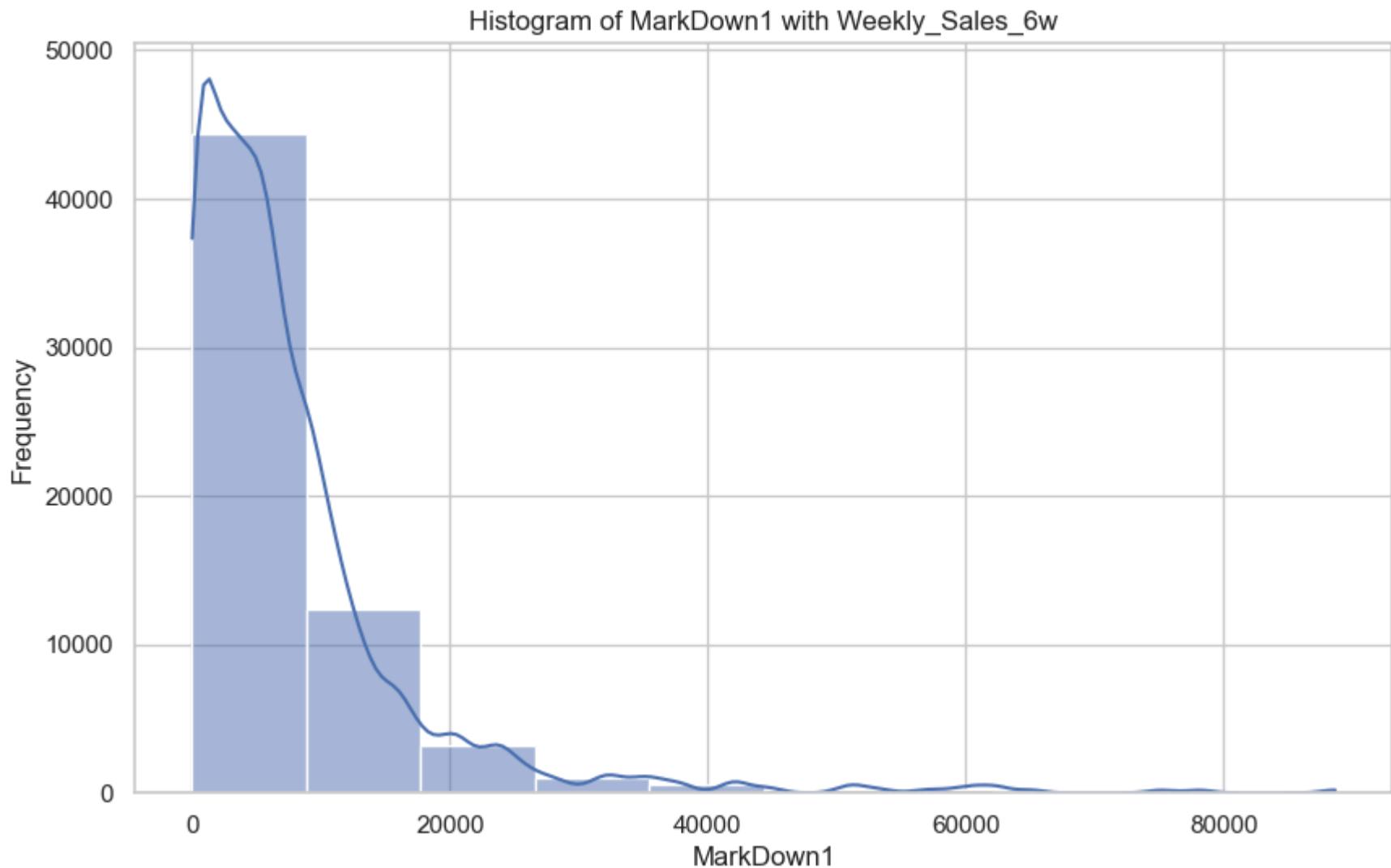
Histogram of Fuel_Price with Weekly_Sales_6w



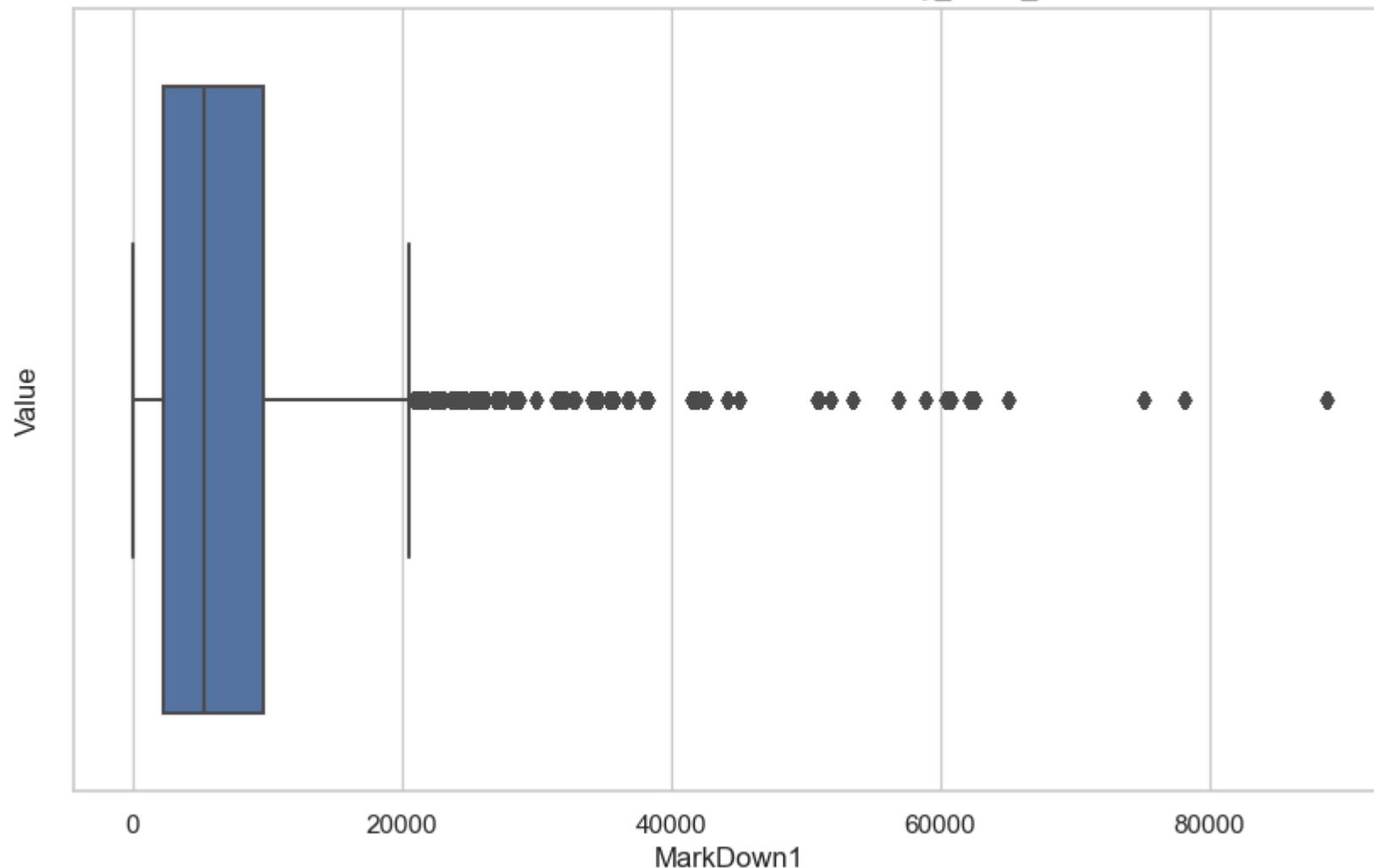
Box Plot of Fuel_Price in Data with Weekly_Sales_6w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

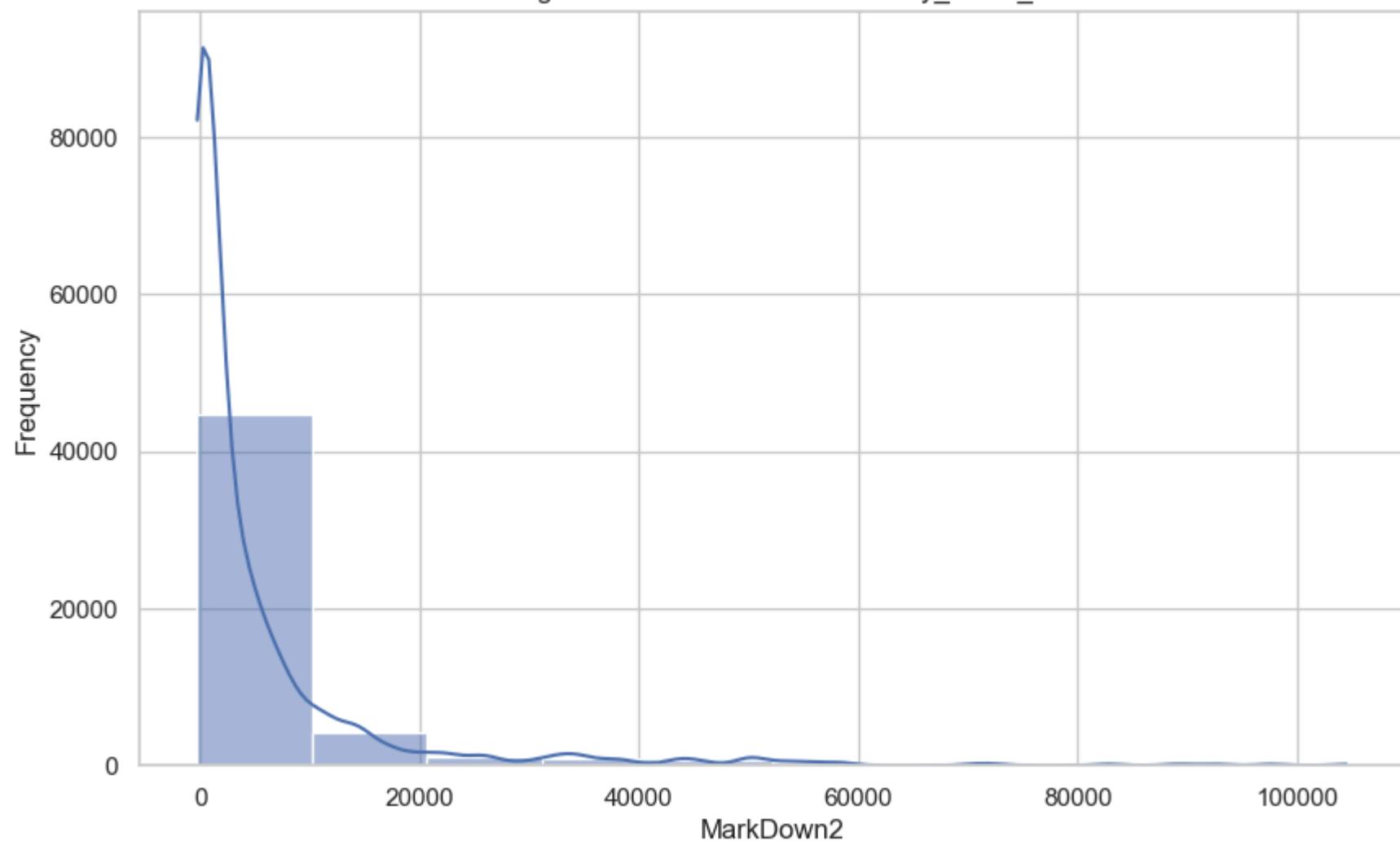


Box Plot of MarkDown1 in Data with Weekly_Sales_6w

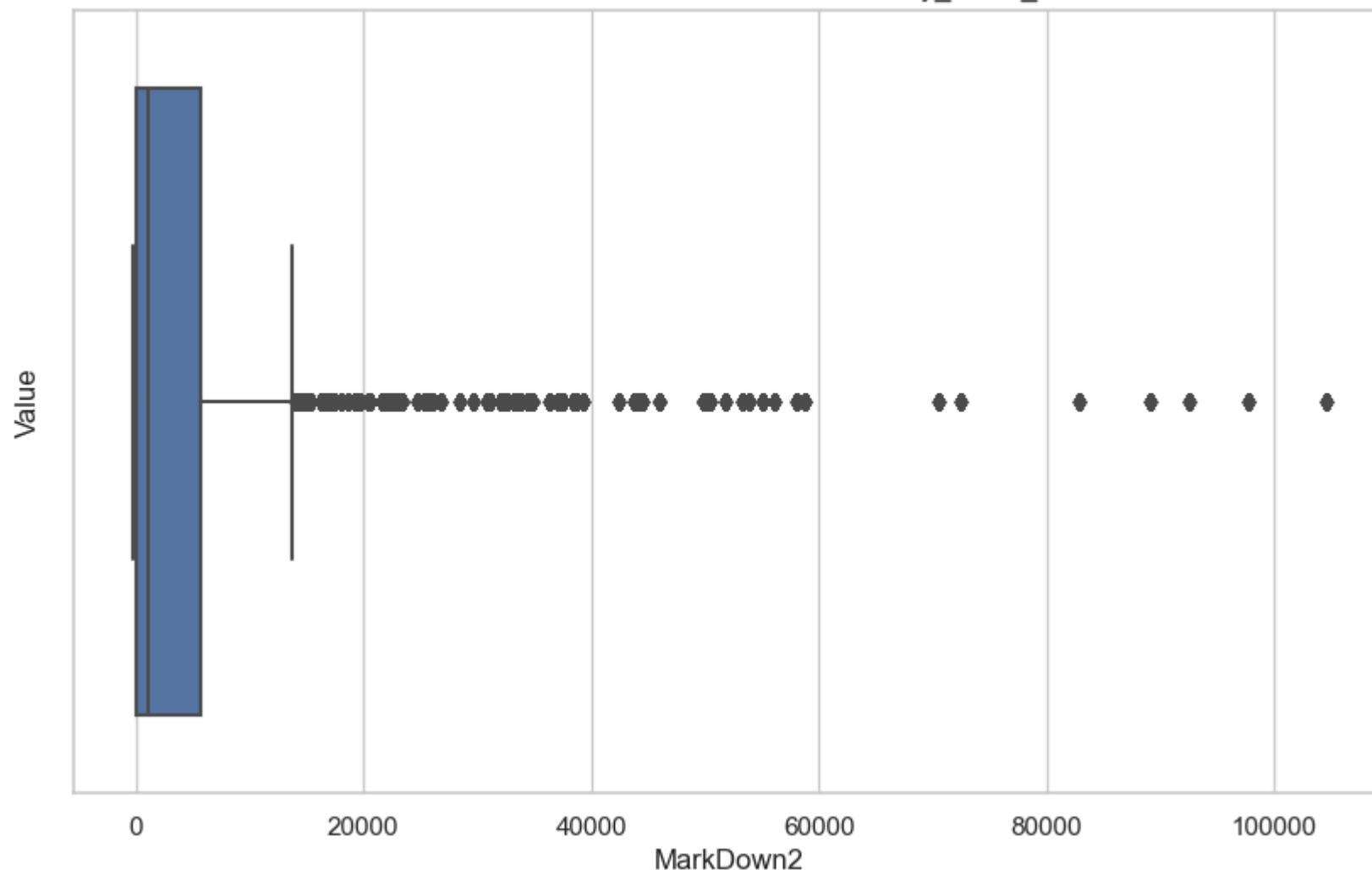


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_6w

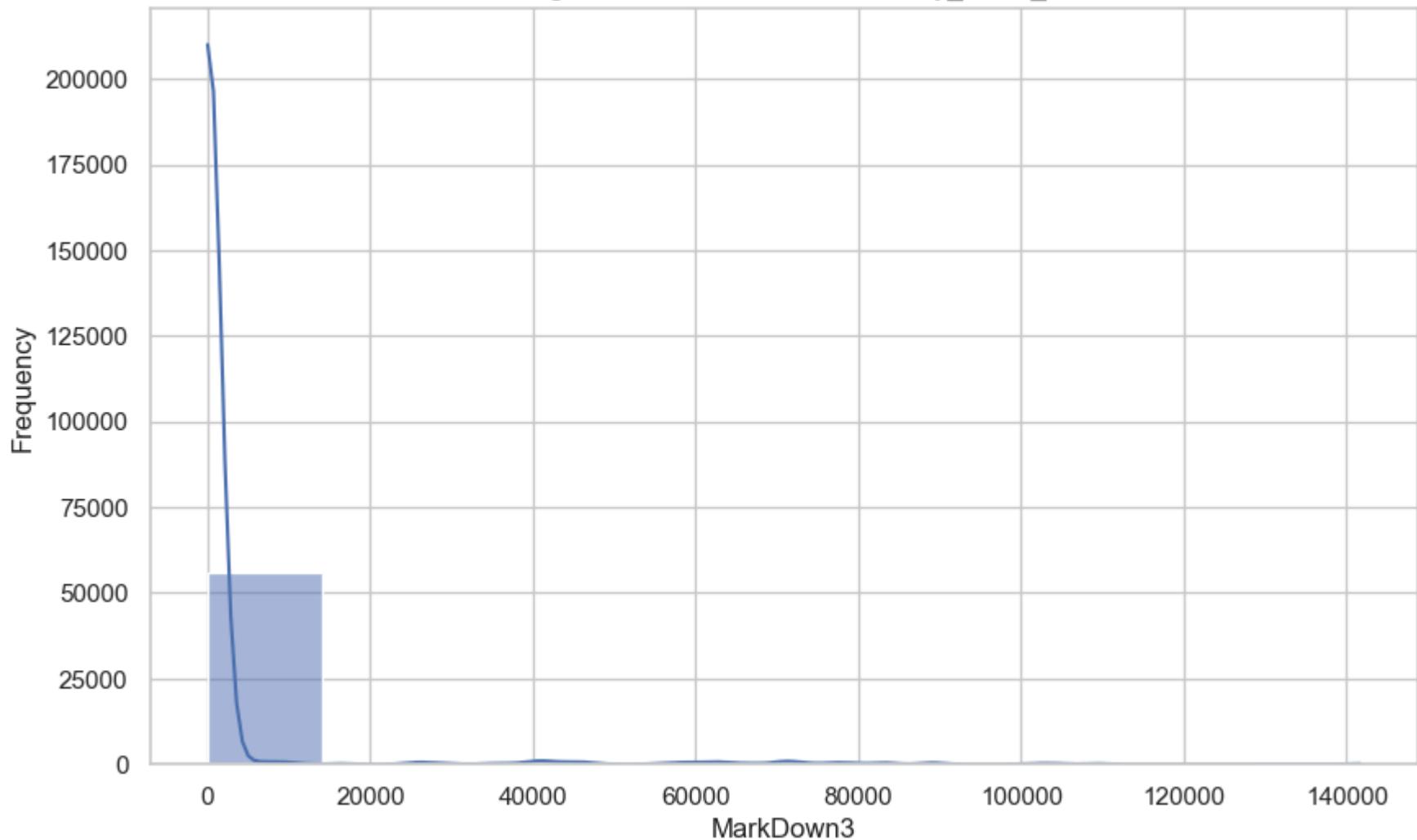


Box Plot of MarkDown2 in Data with Weekly_Sales_6w

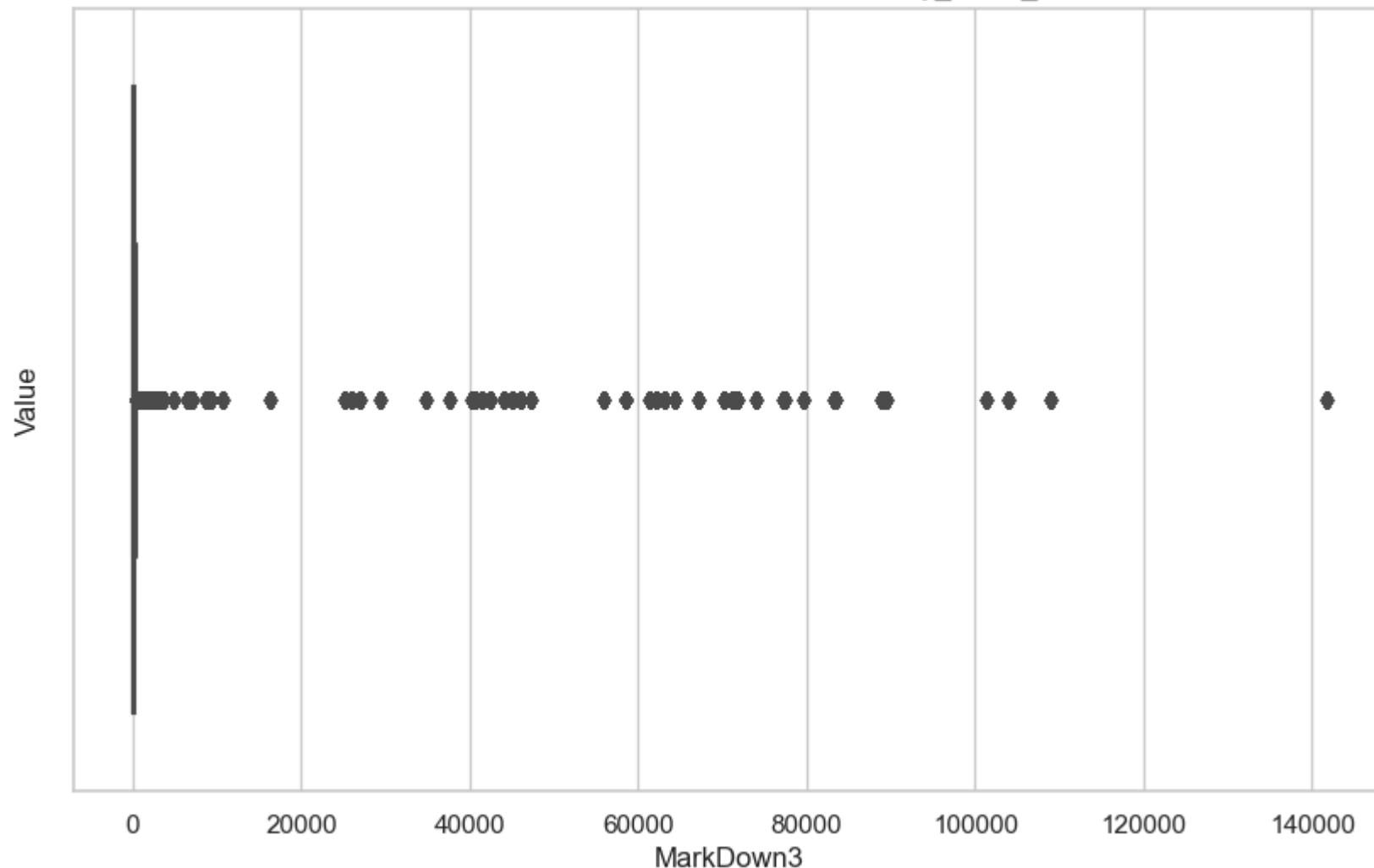


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_6w

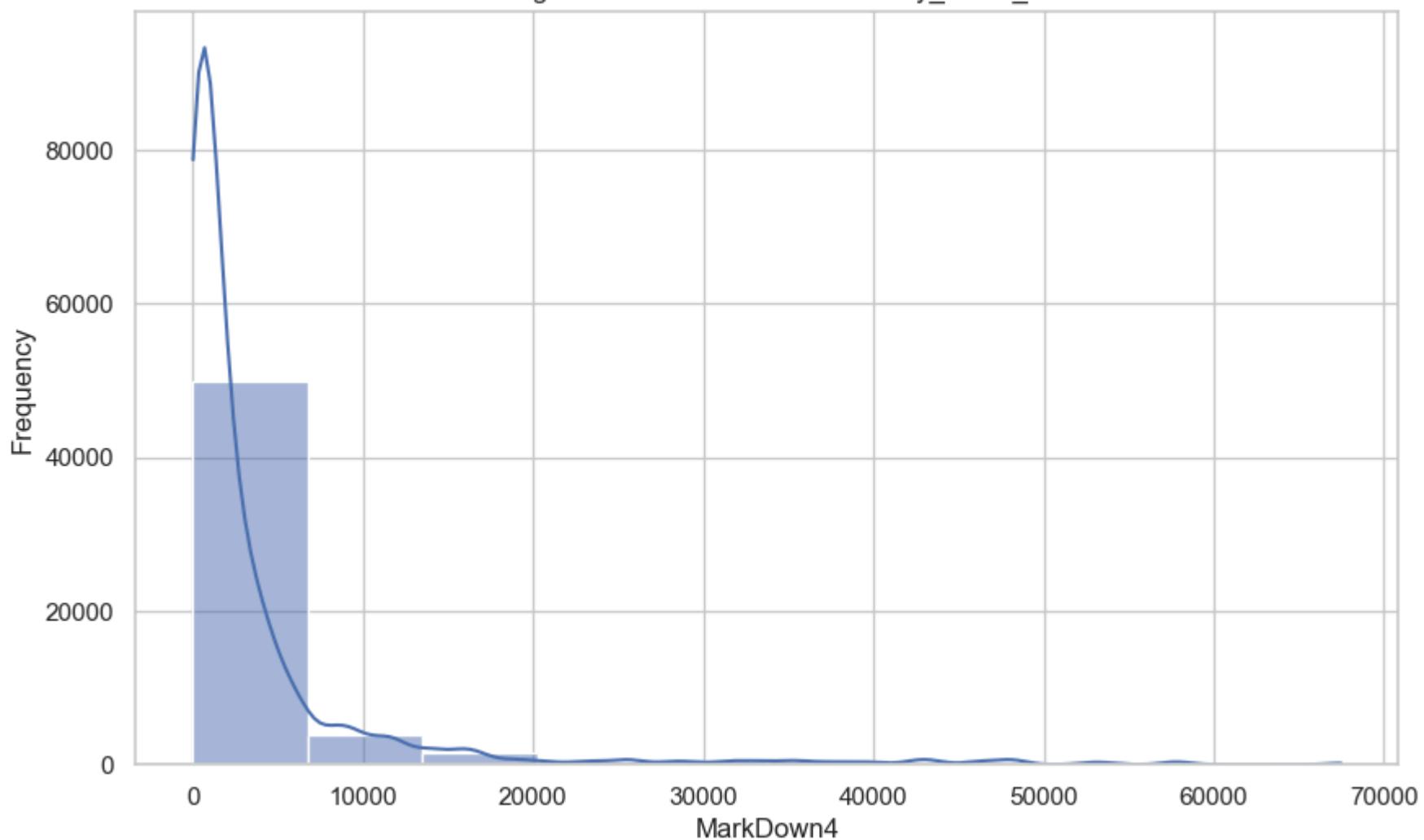


Box Plot of MarkDown3 in Data with Weekly_Sales_6w

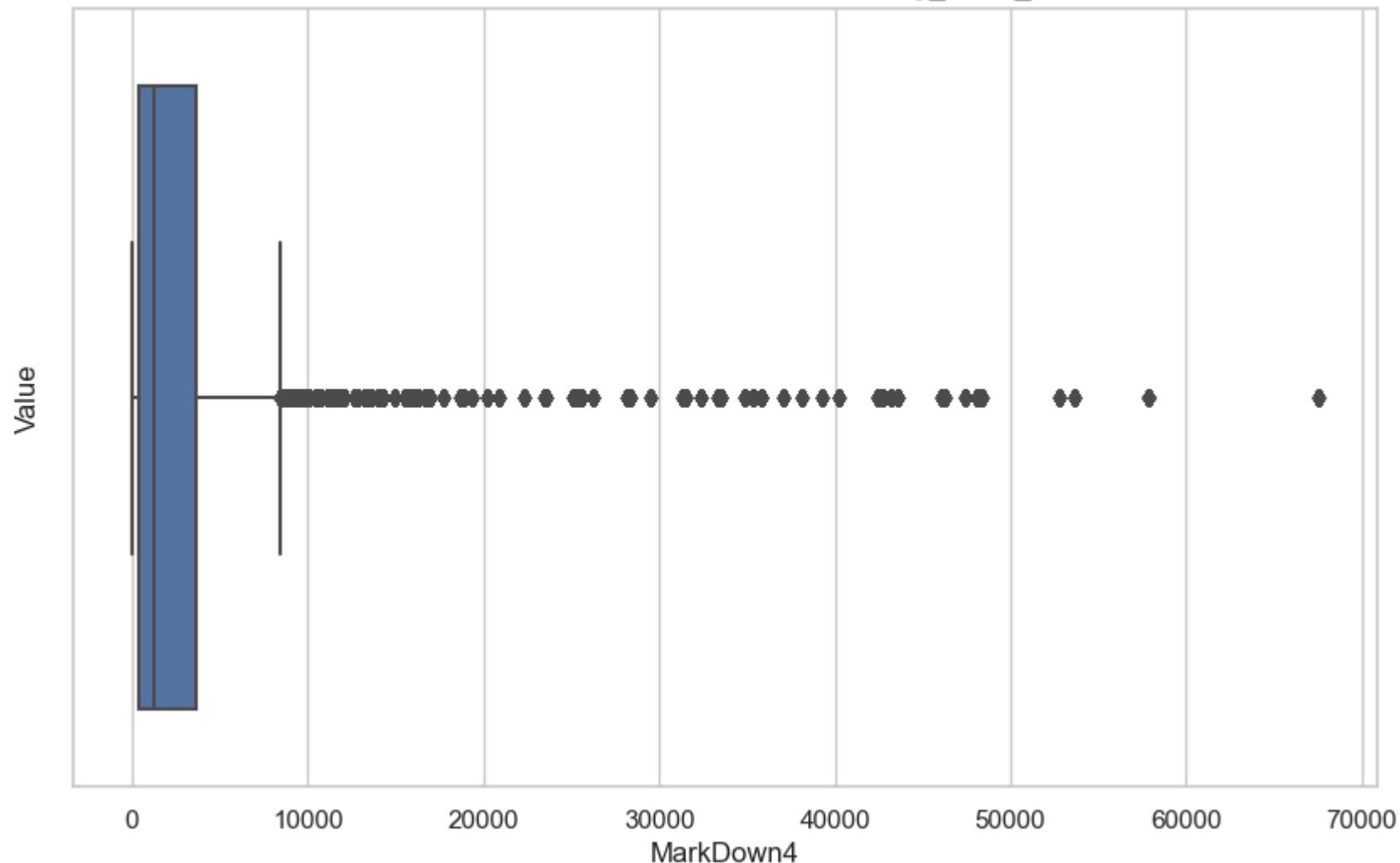


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_6w

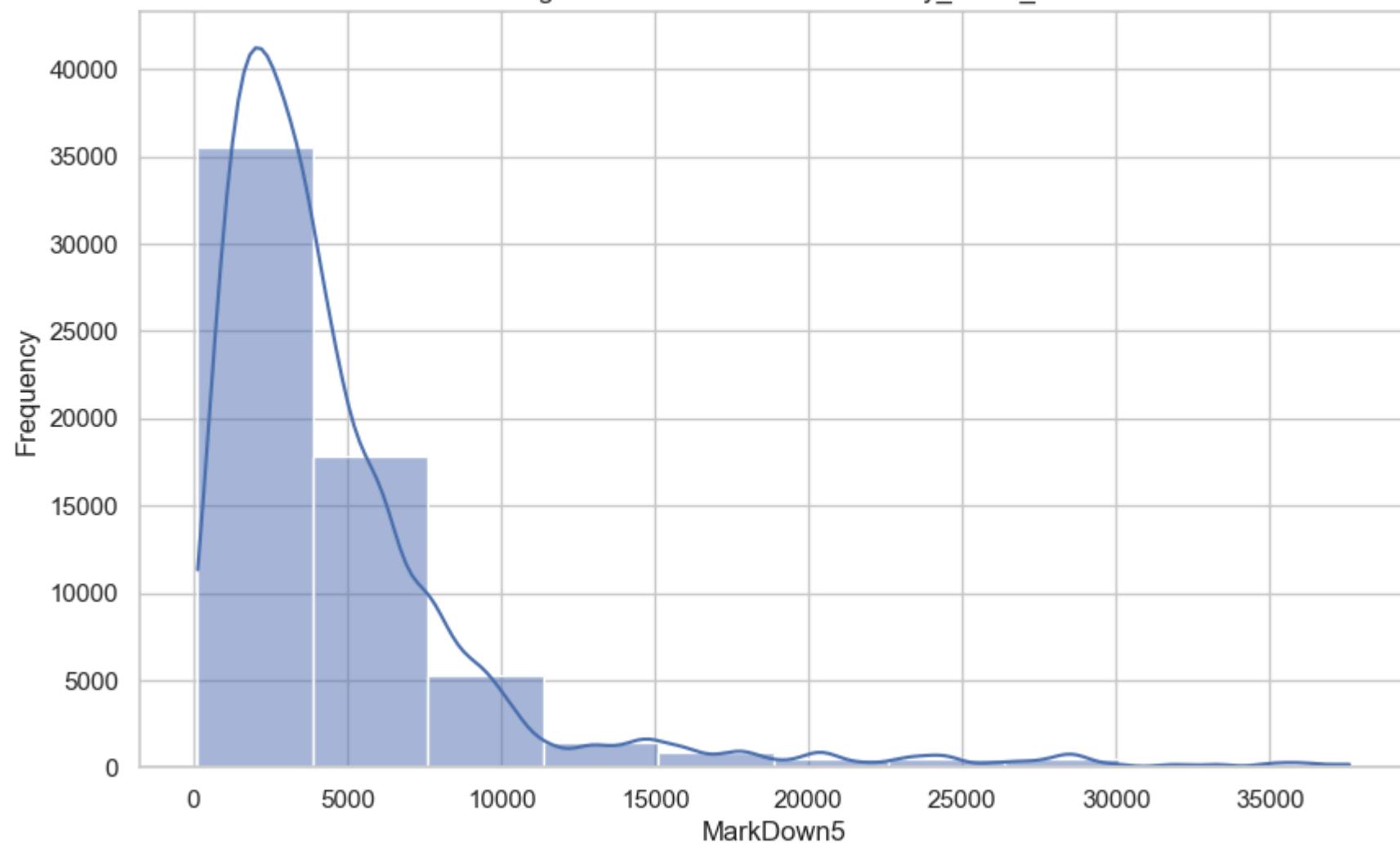


Box Plot of MarkDown4 in Data with Weekly_Sales_6w

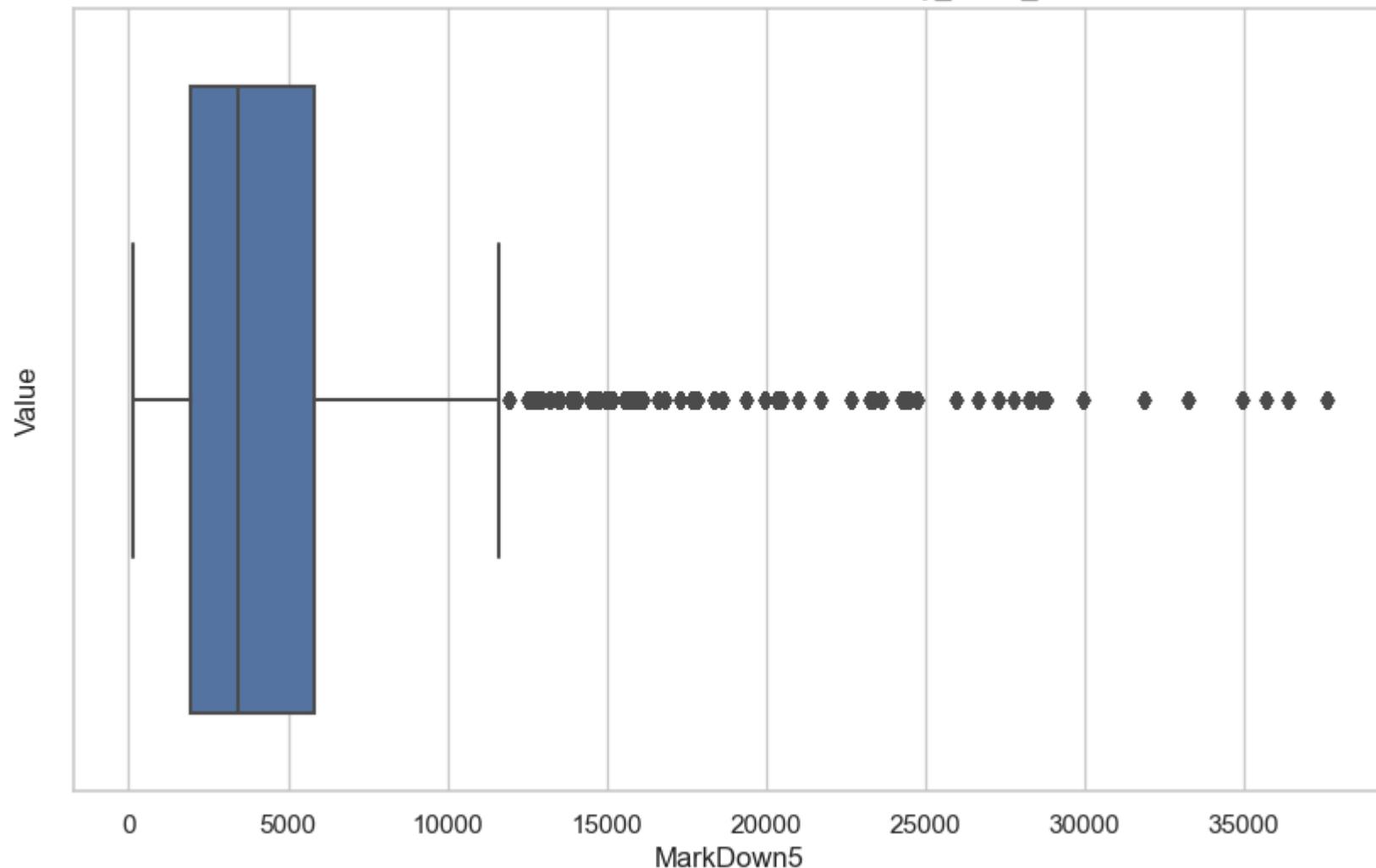


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_6w

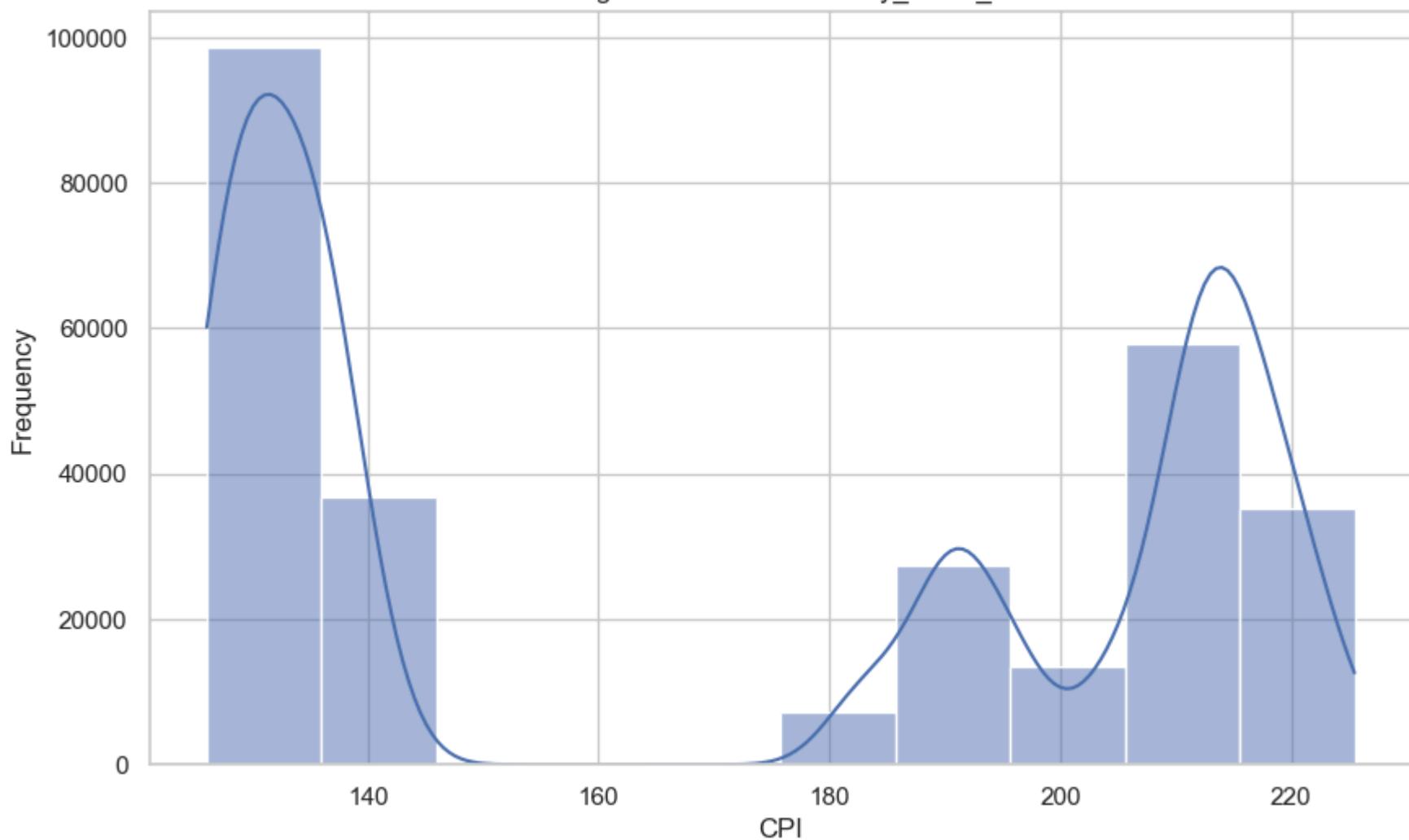


Box Plot of MarkDown5 in Data with Weekly_Sales_6w

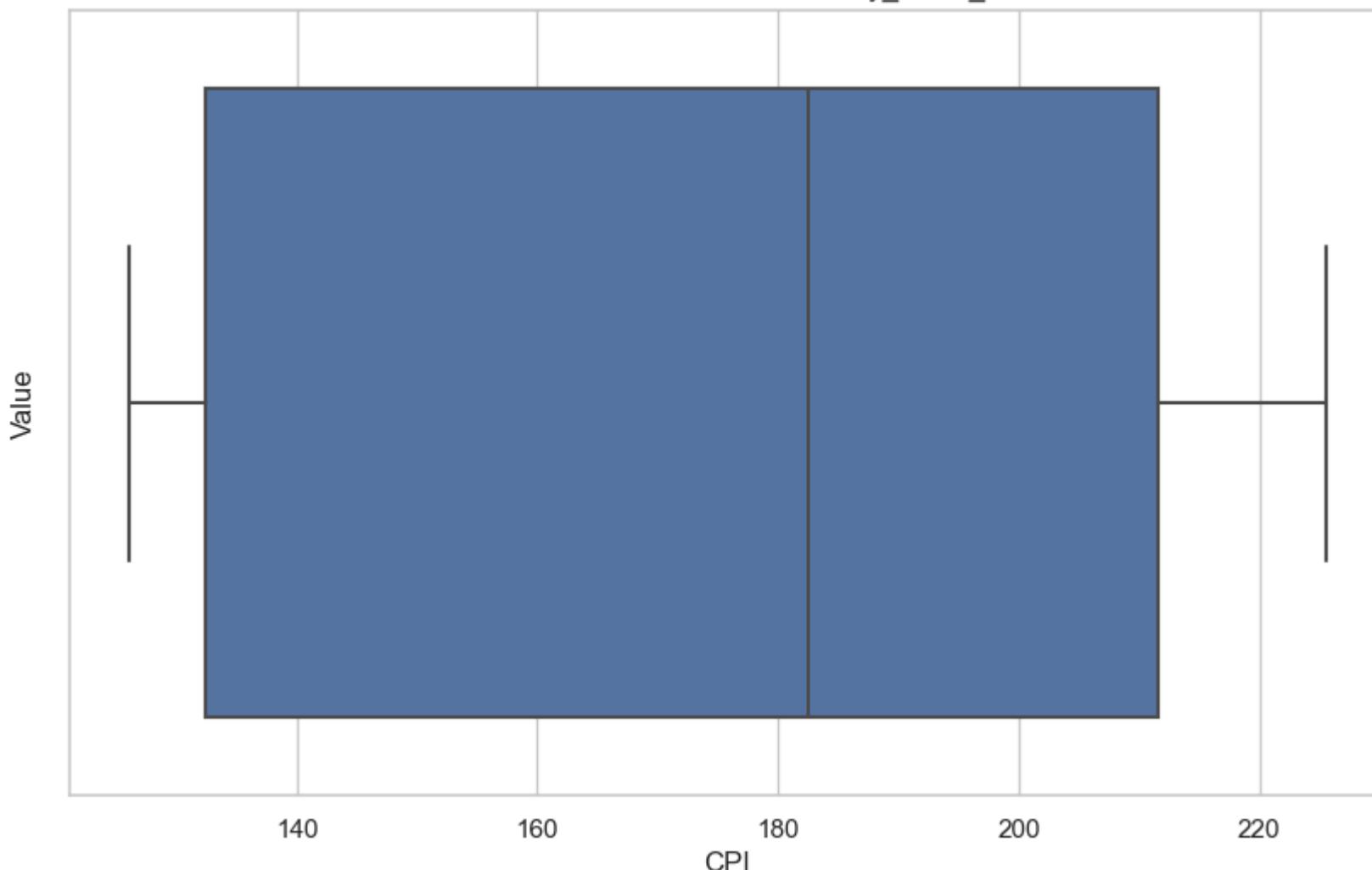


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_6w

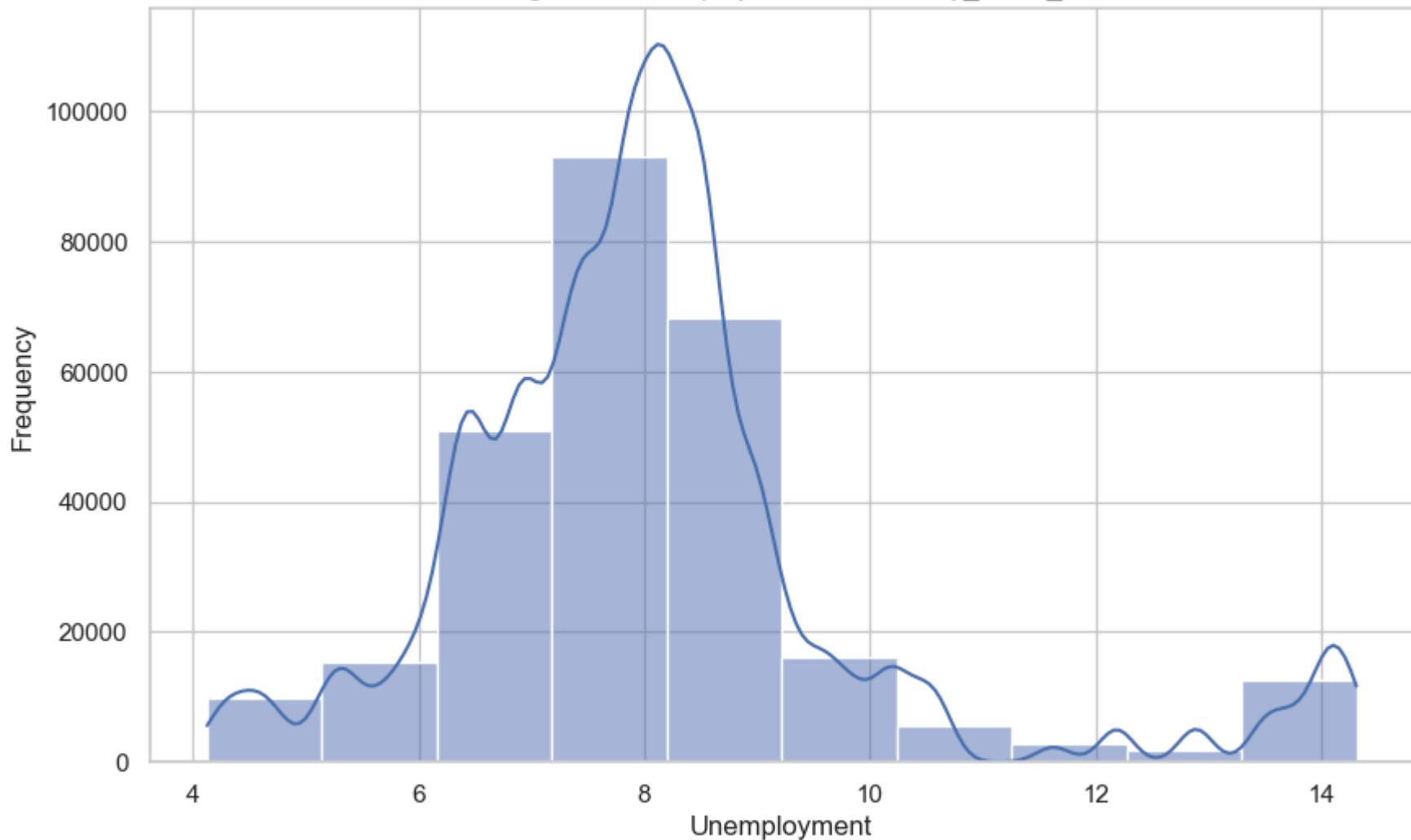


Box Plot of CPI in Data with Weekly_Sales_6w

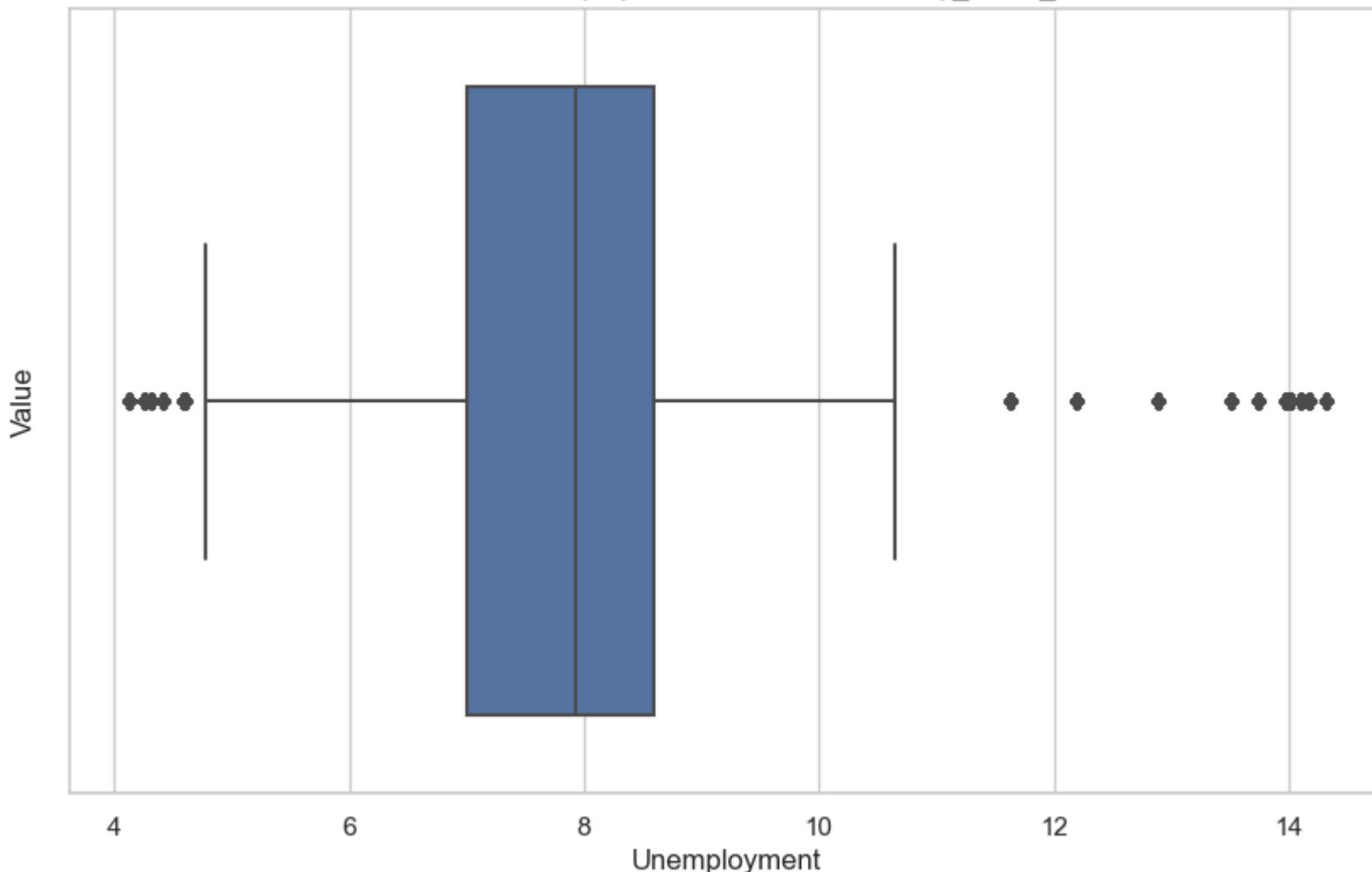


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_6w

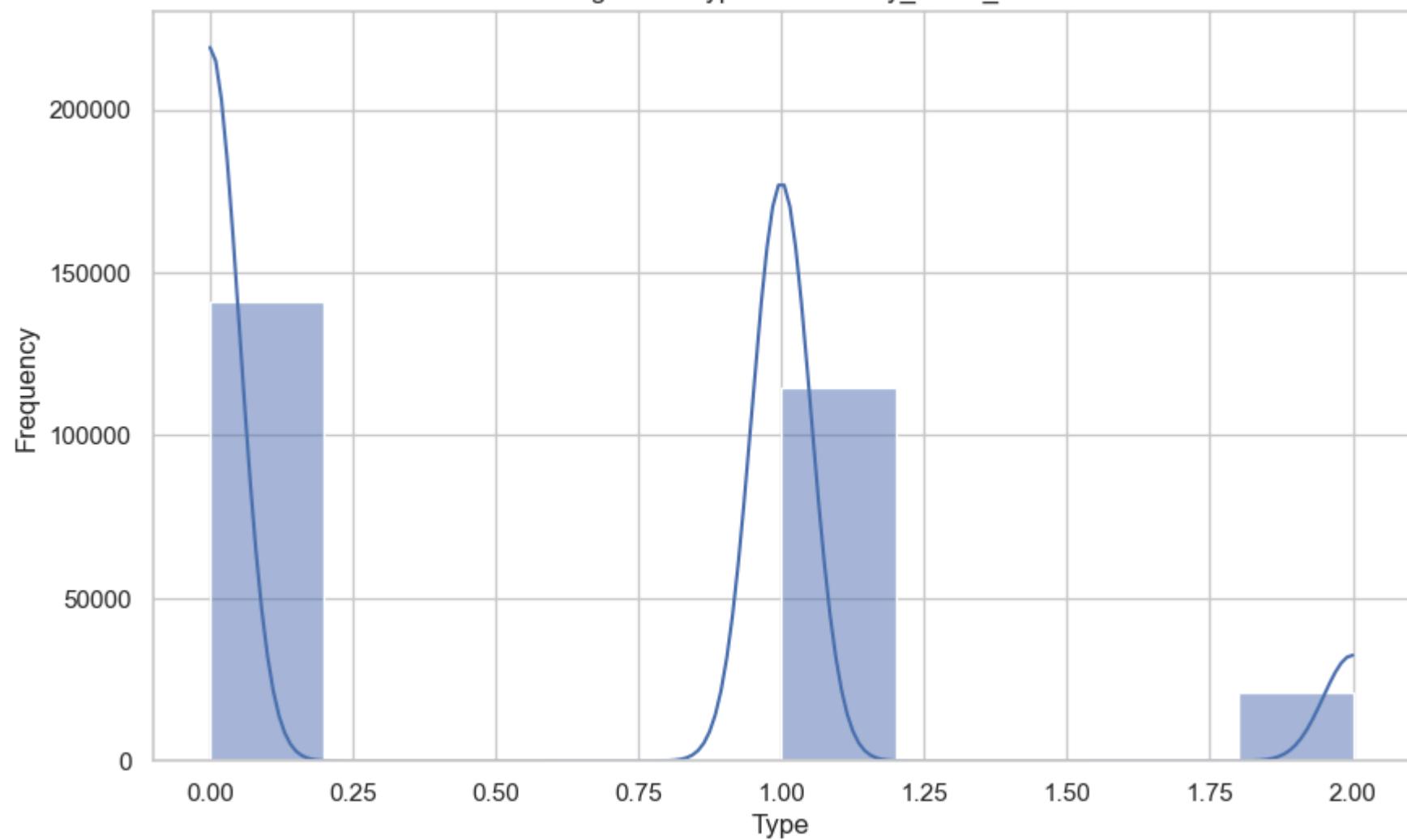


Box Plot of Unemployment in Data with Weekly_Sales_6w

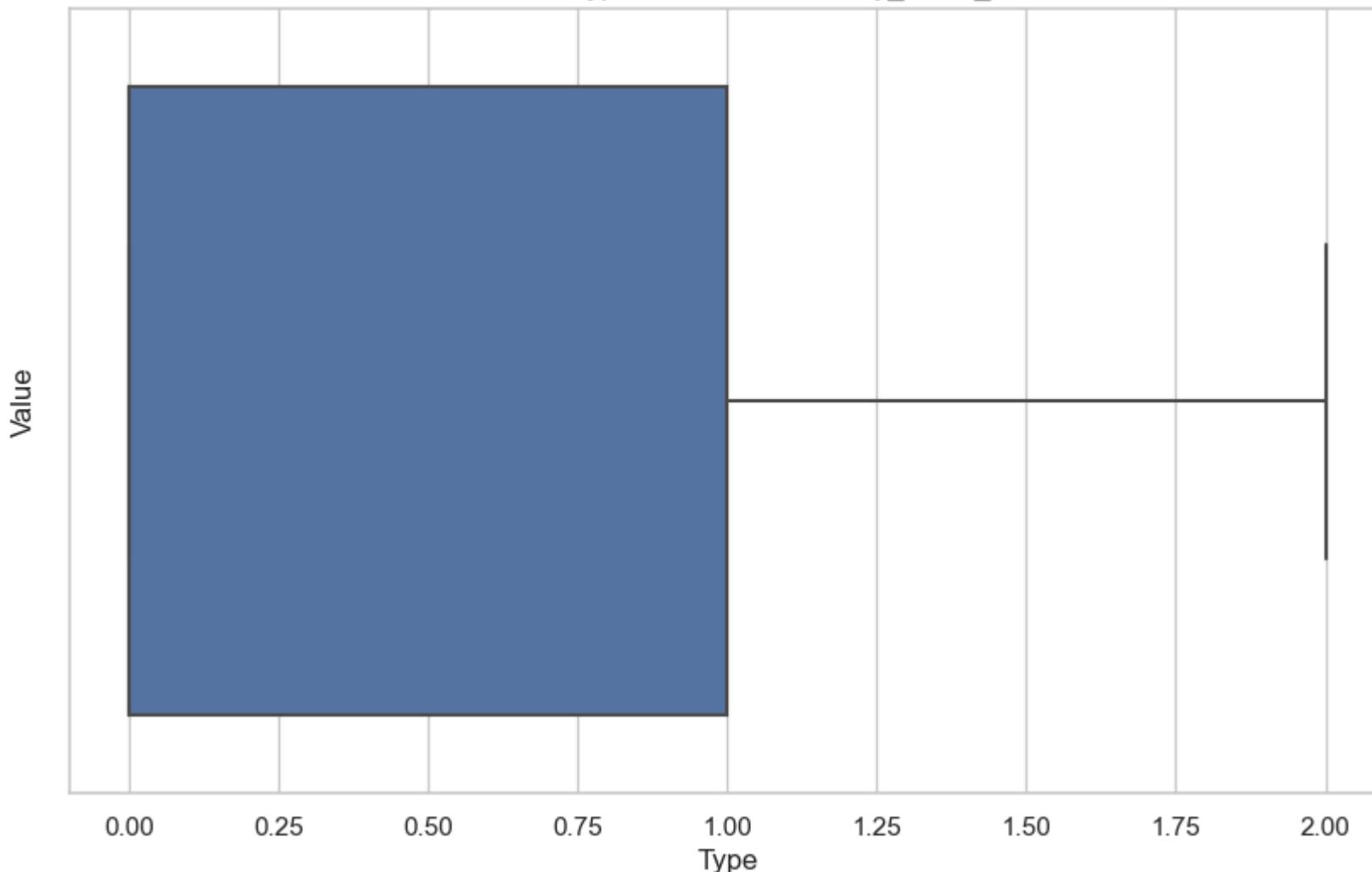


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_6w

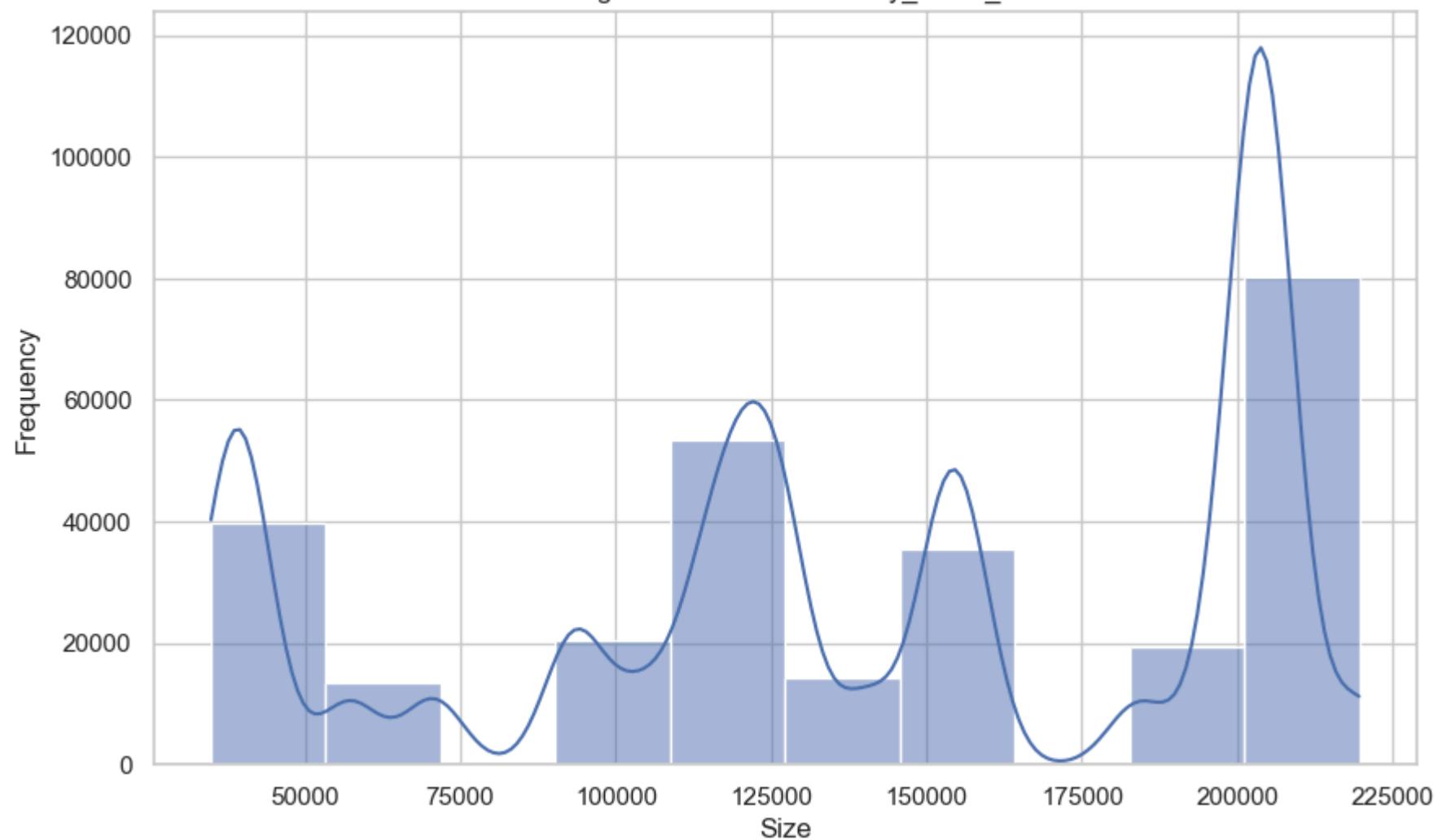


Box Plot of Type in Data with Weekly_Sales_6w

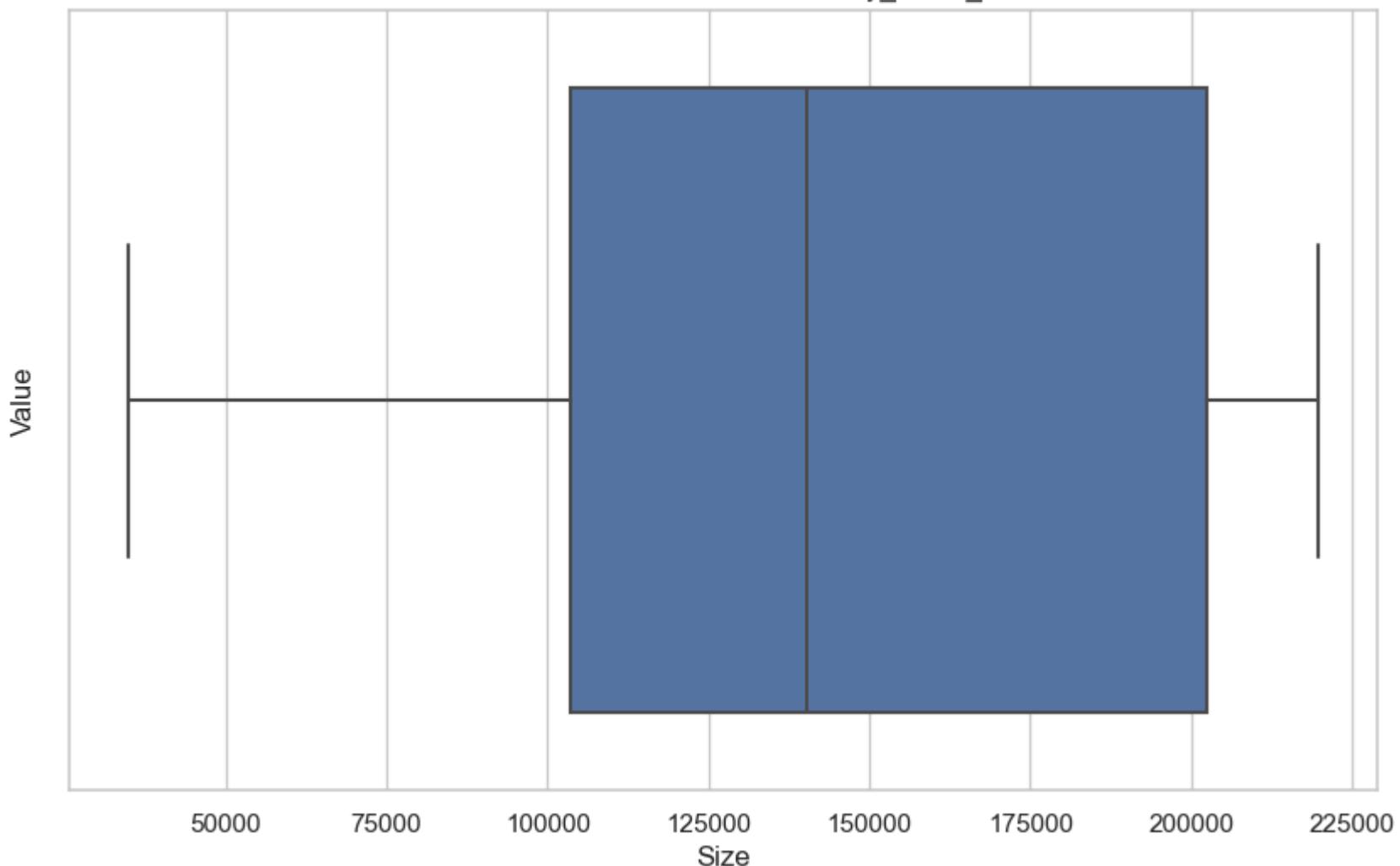


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_6w

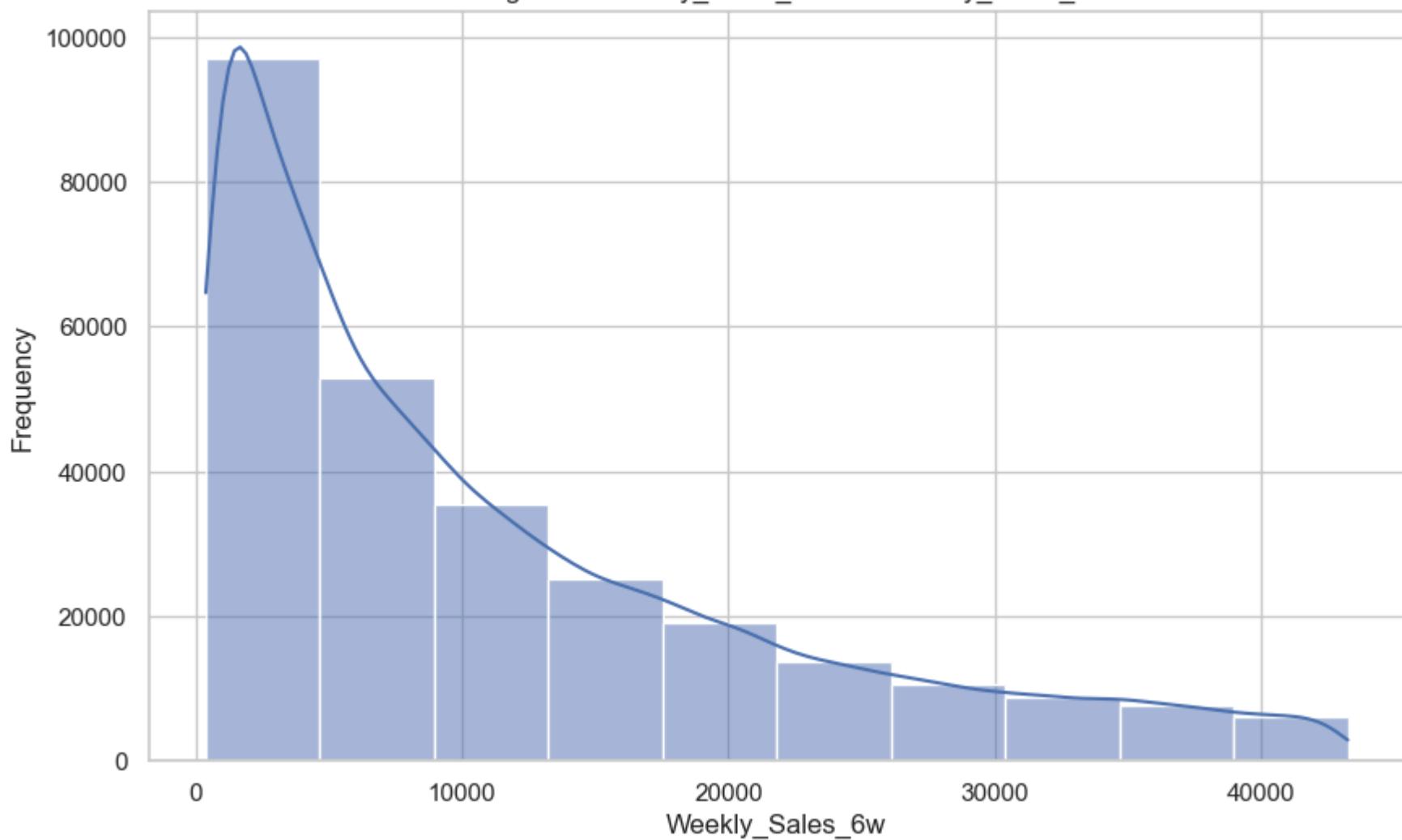


Box Plot of Size in Data with Weekly_Sales_6w

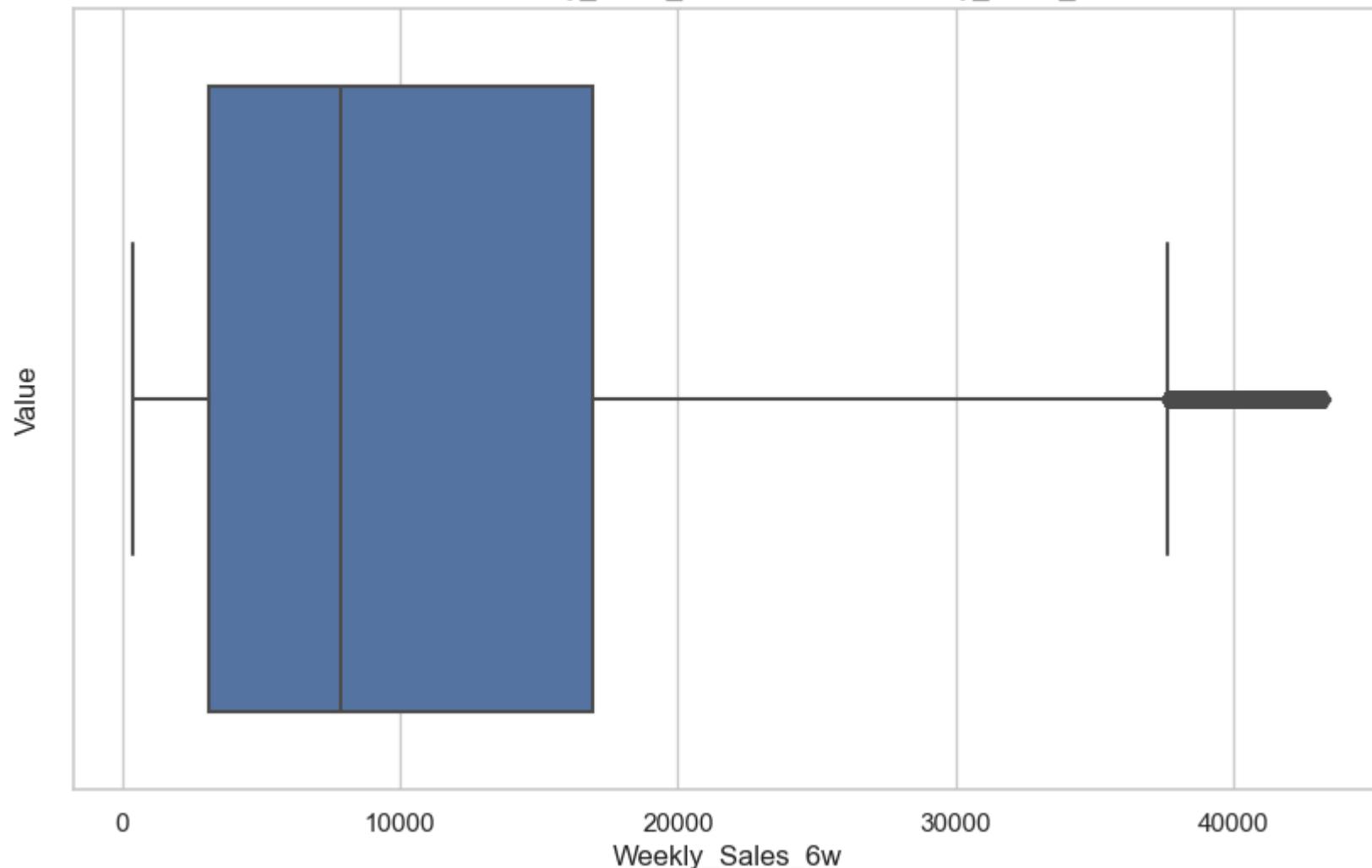


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_6w with Weekly_Sales_6w

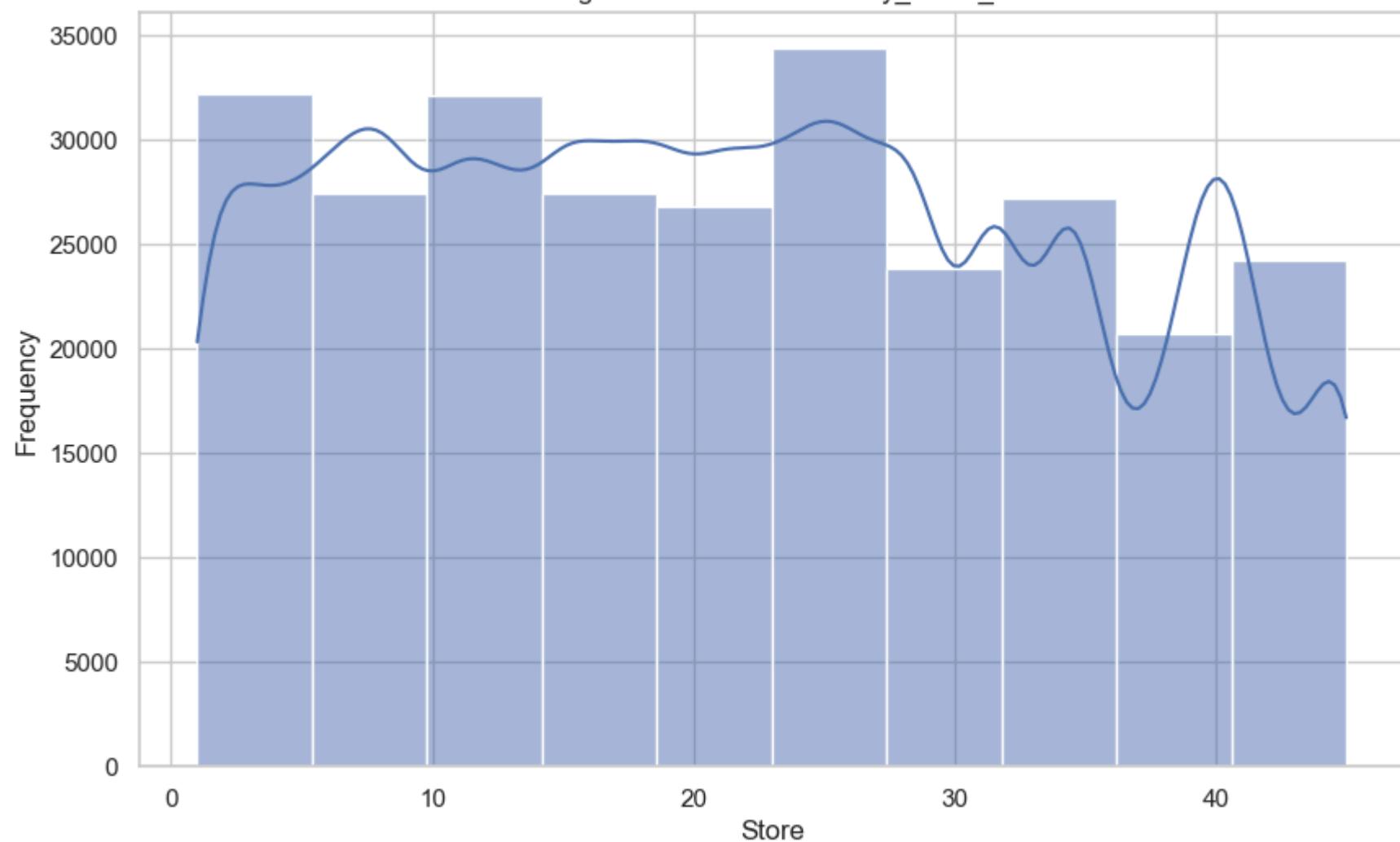


Box Plot of Weekly_Sales_6w in Data with Weekly_Sales_6w

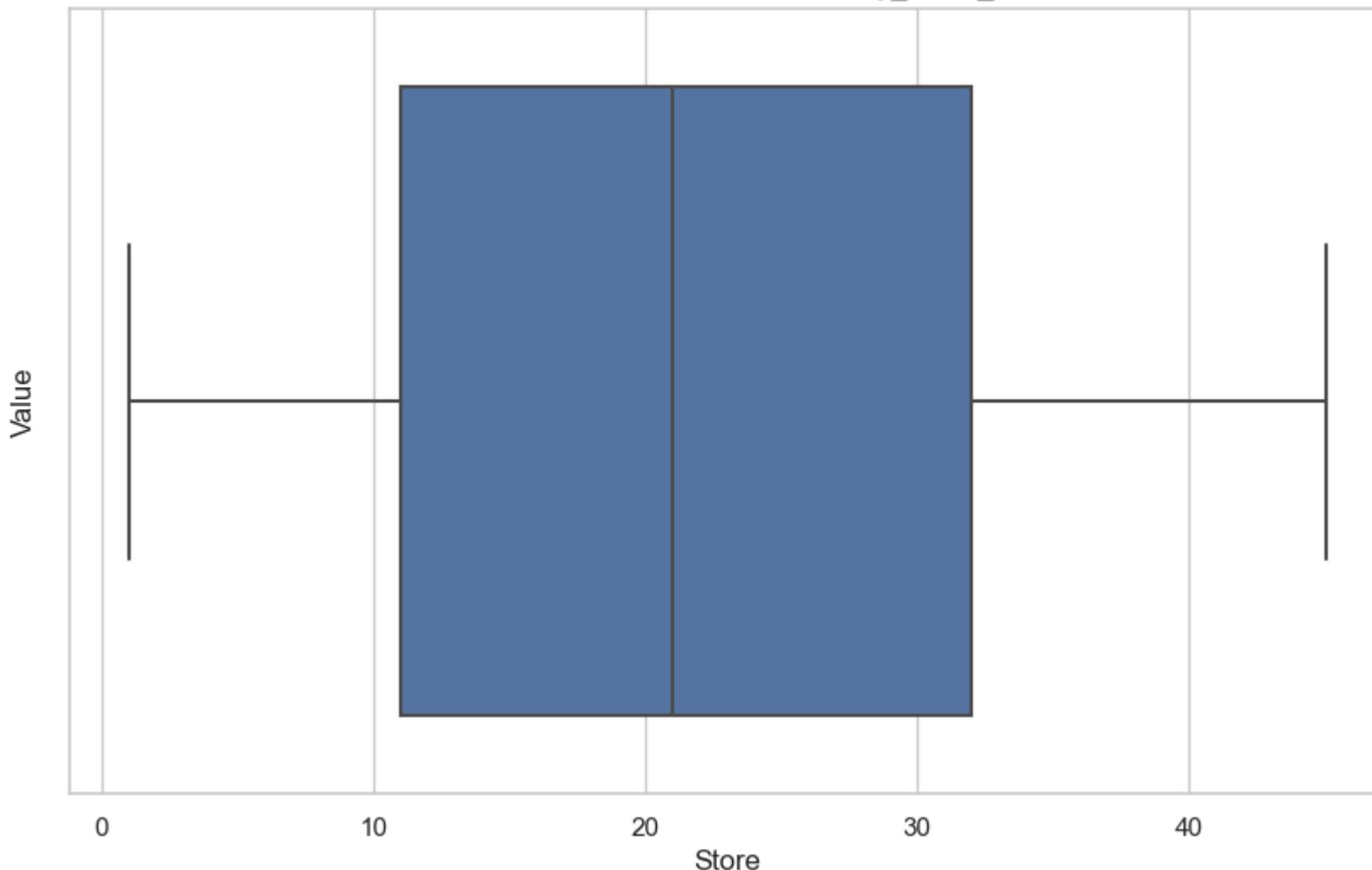


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_7w

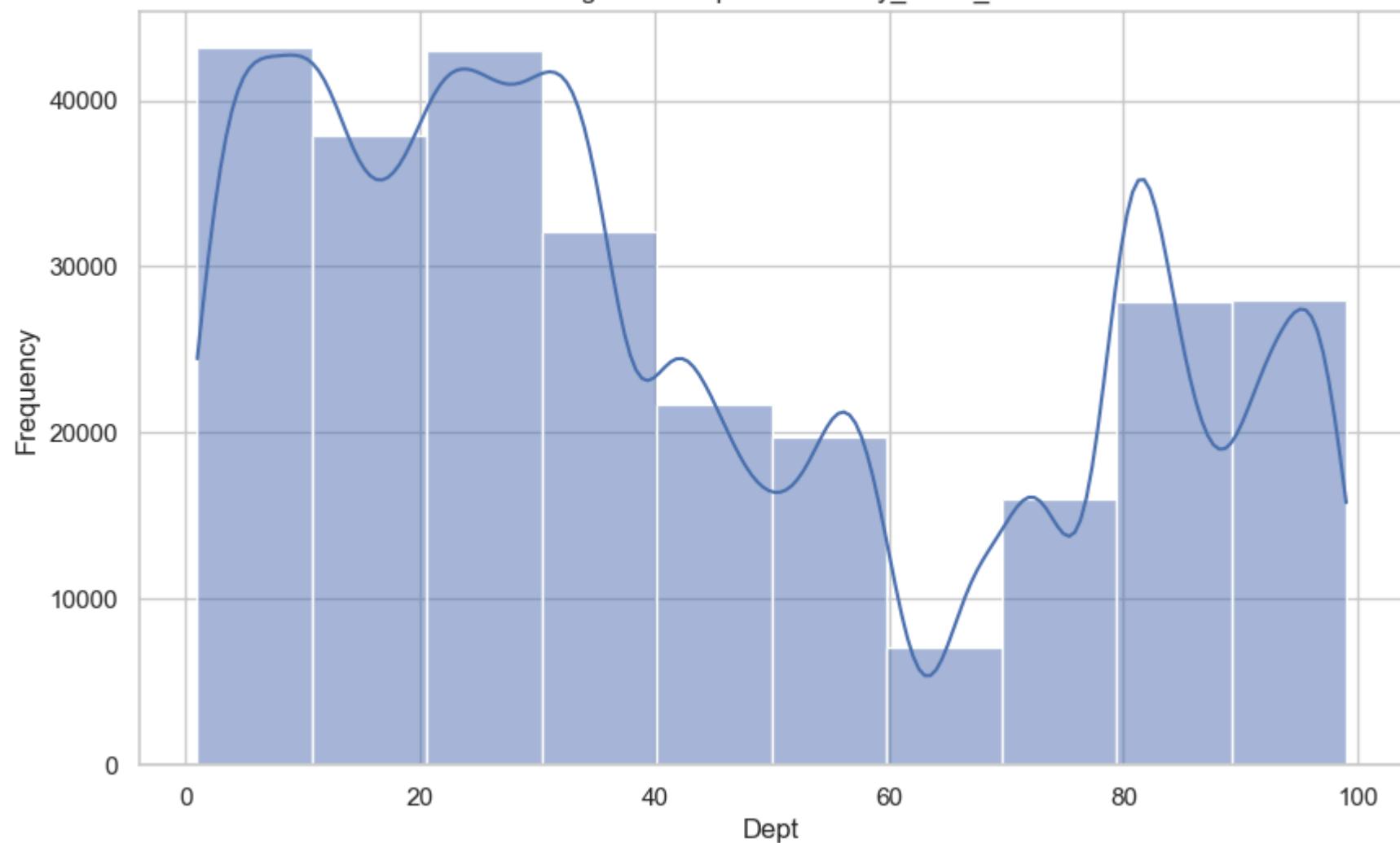


Box Plot of Store in Data with Weekly_Sales_7w

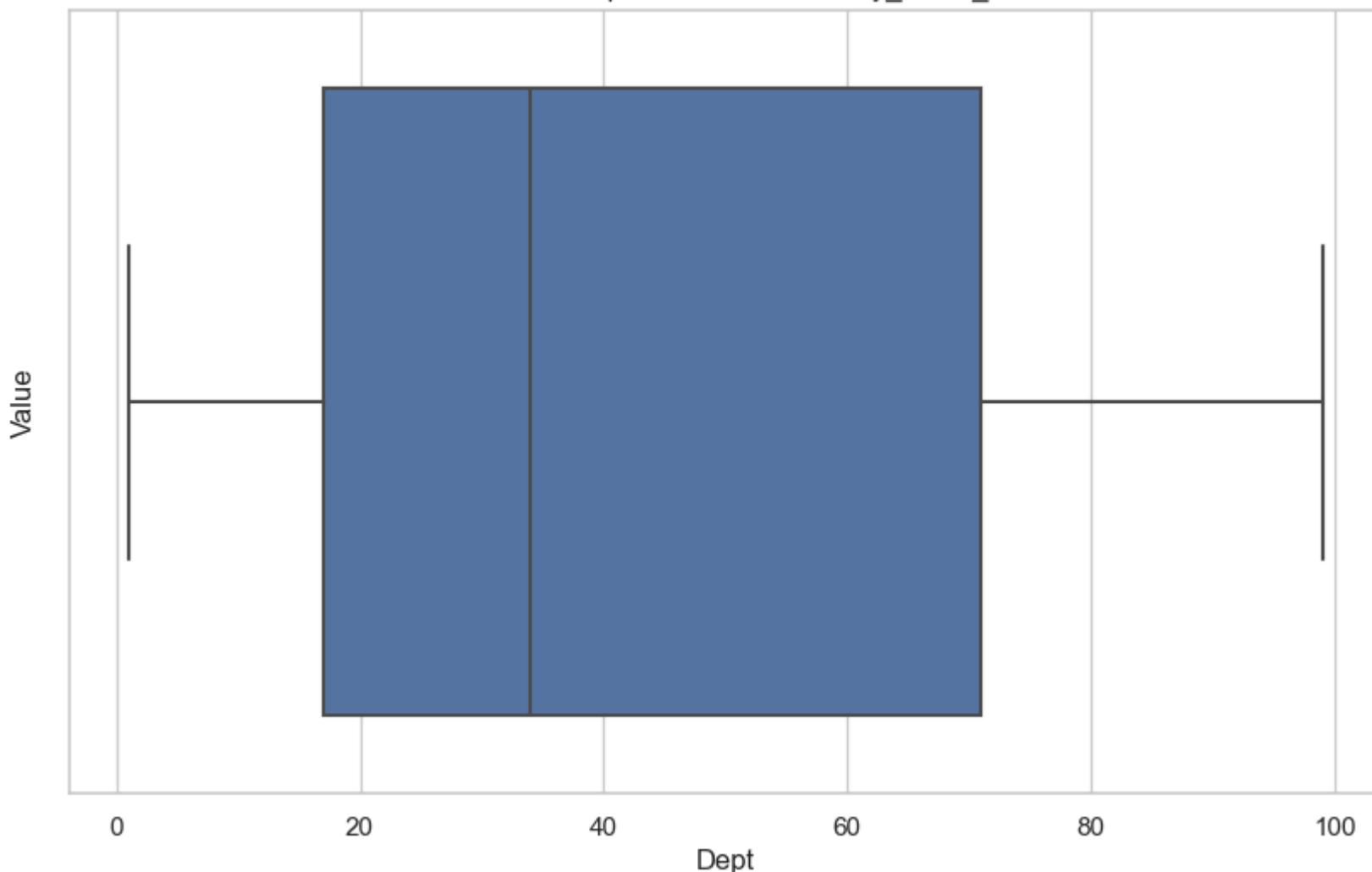


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_7w

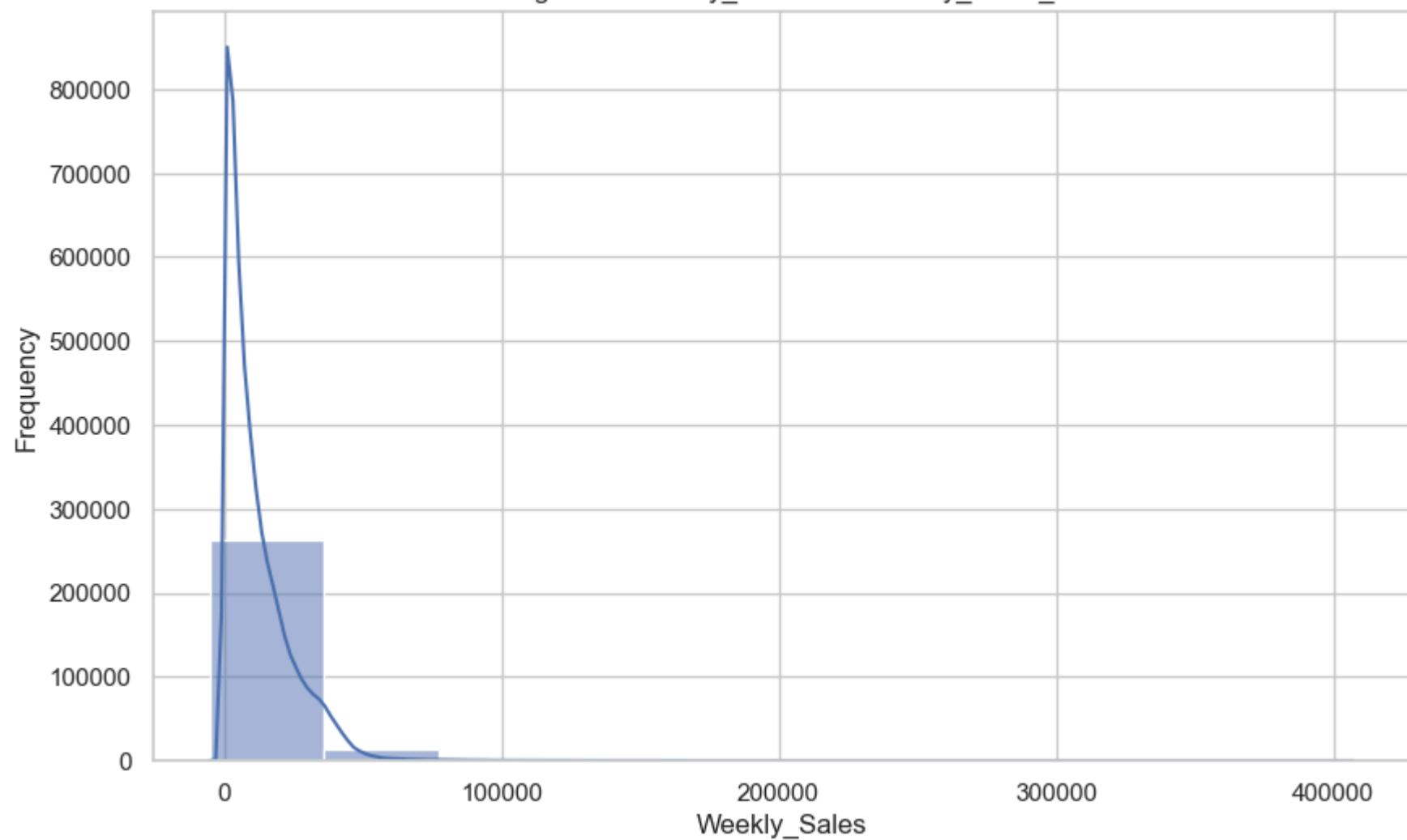


Box Plot of Dept in Data with Weekly_Sales_7w

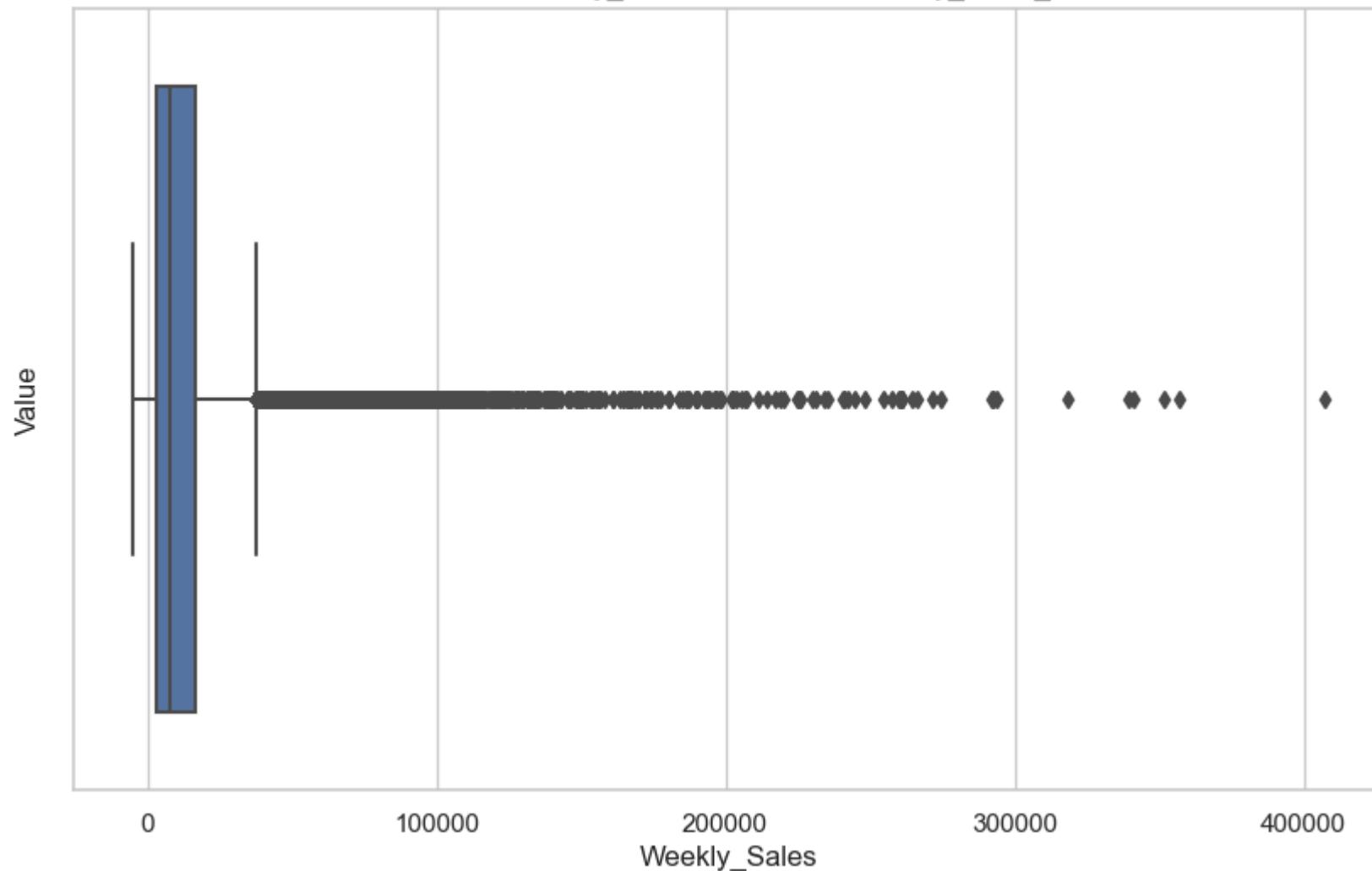


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_7w

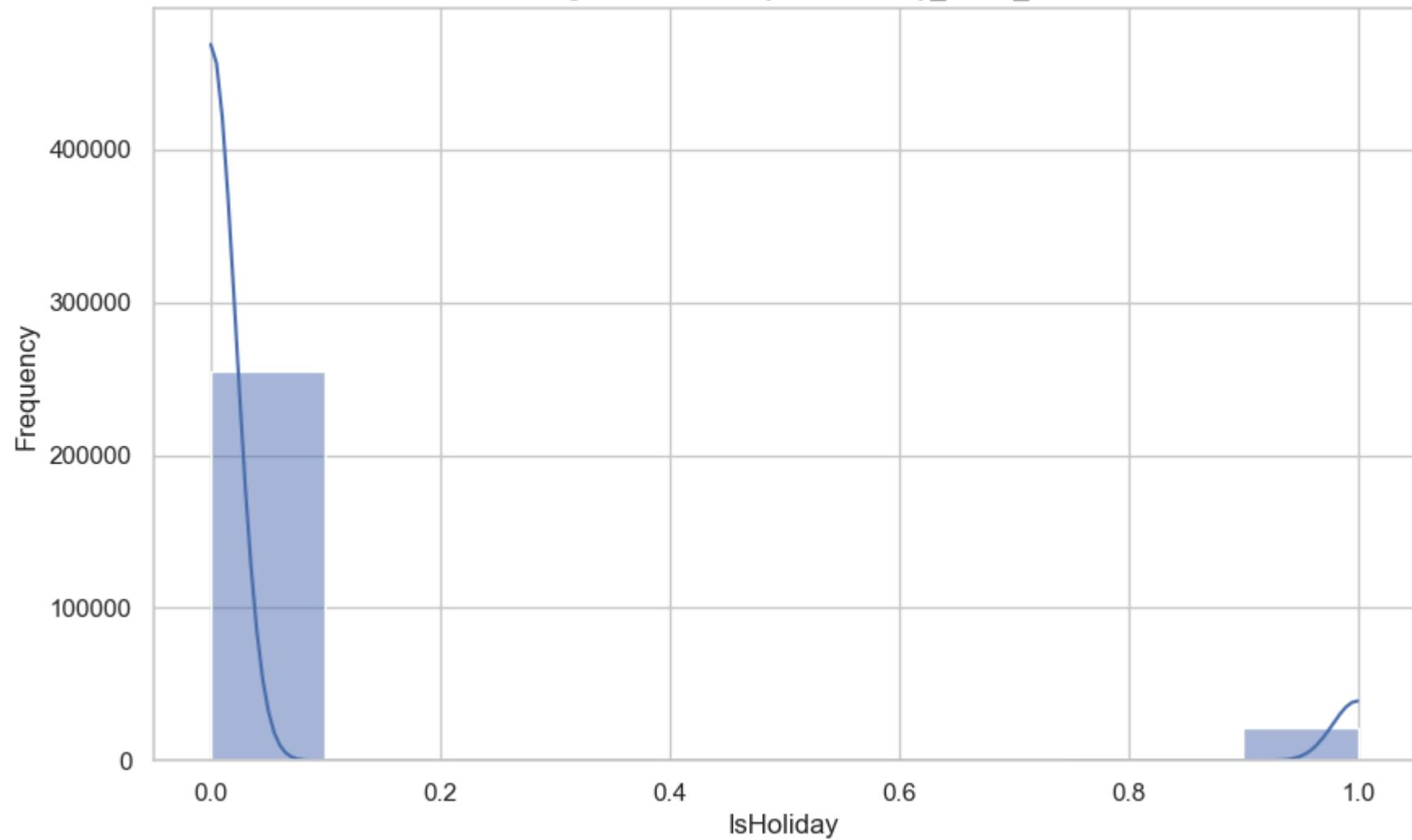


Box Plot of Weekly_Sales in Data with Weekly_Sales_7w

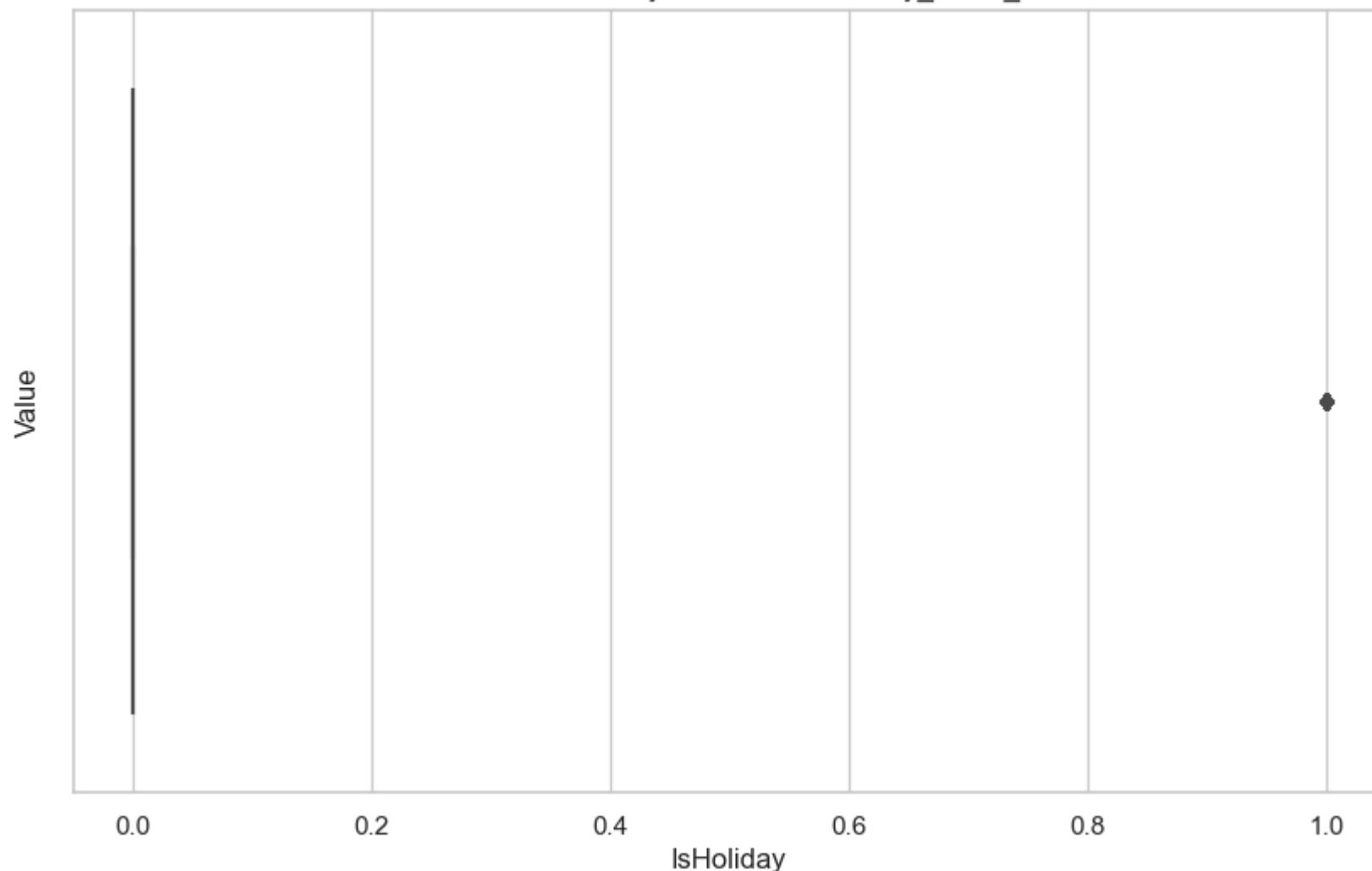


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_7w

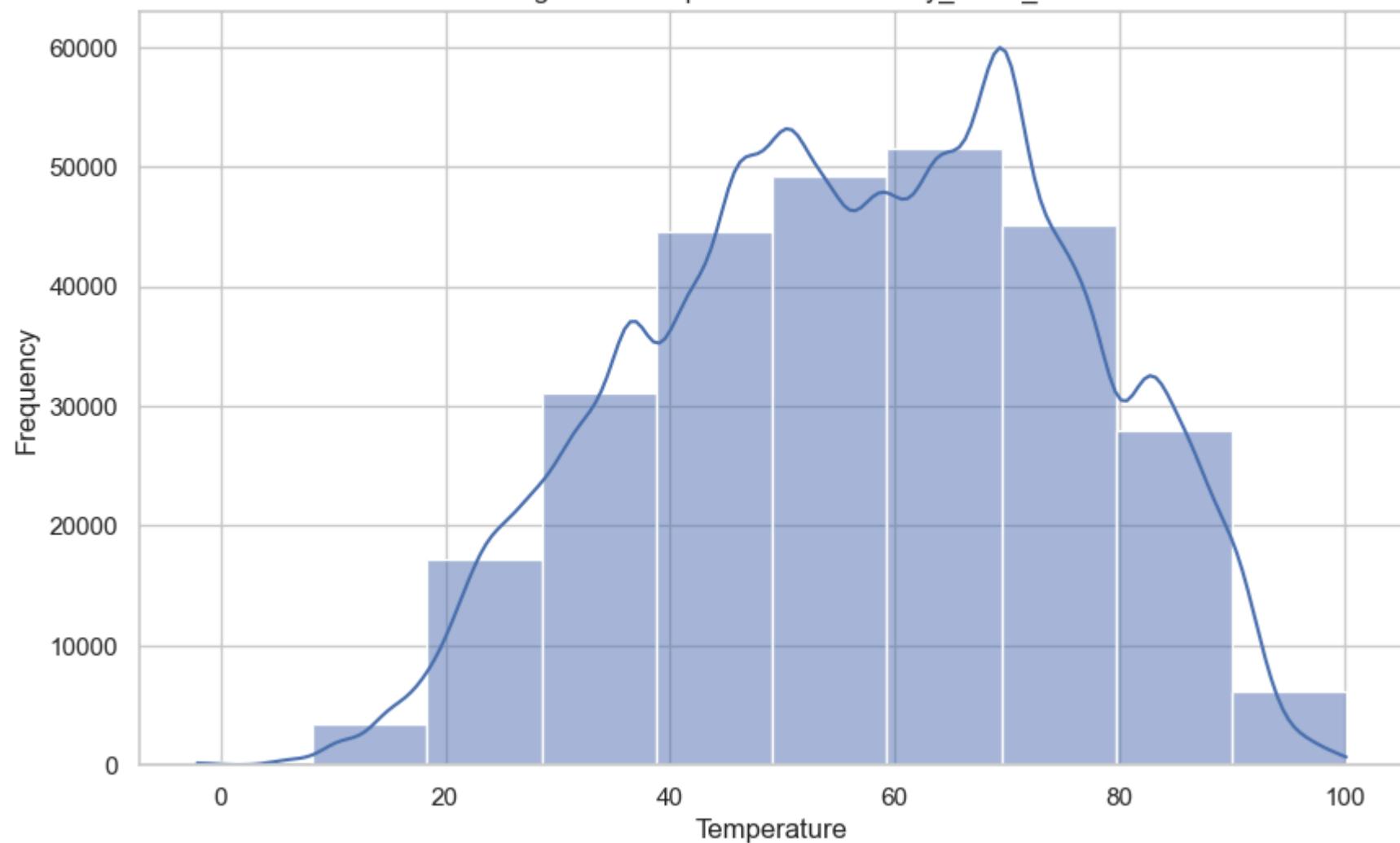


Box Plot of IsHoliday in Data with Weekly_Sales_7w

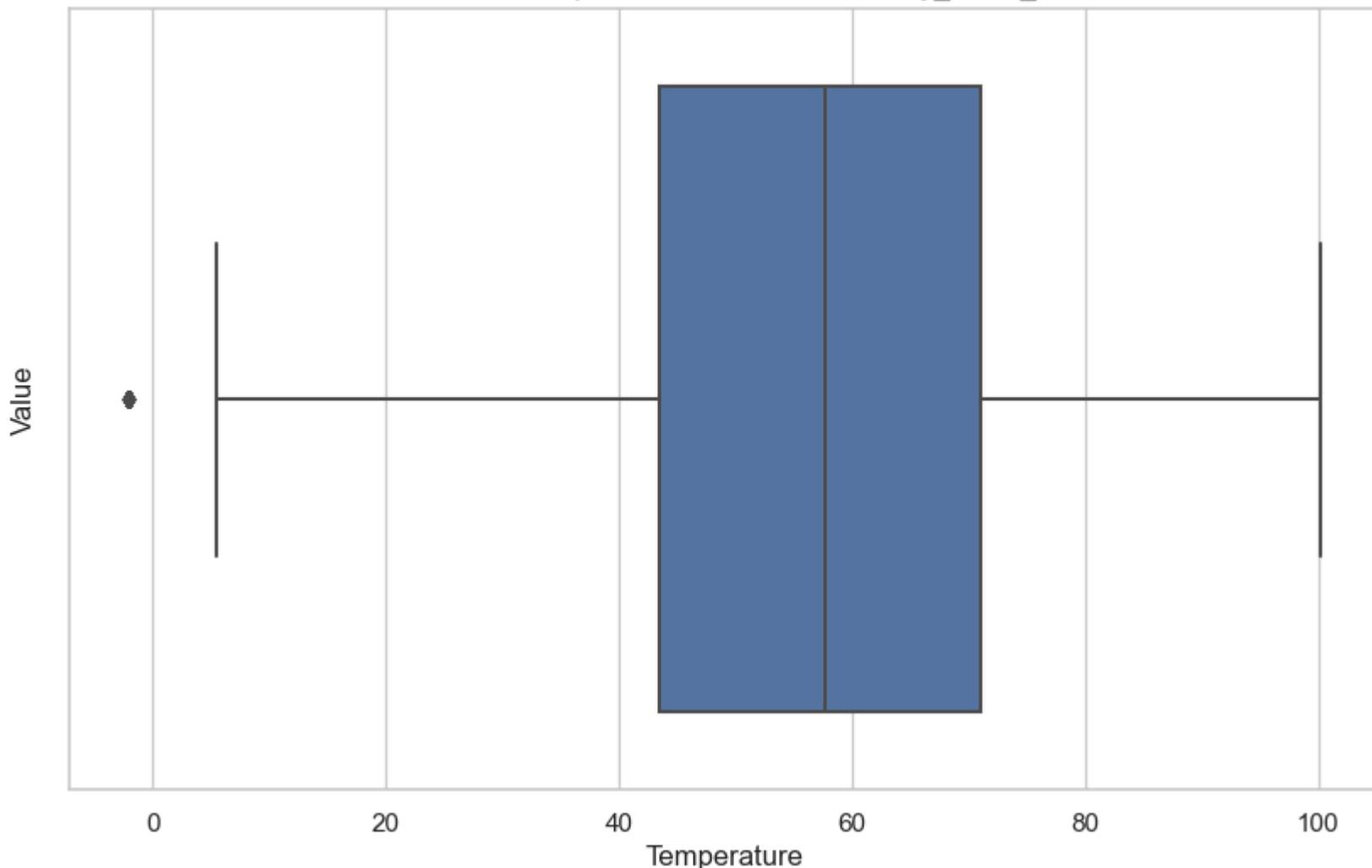


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_7w

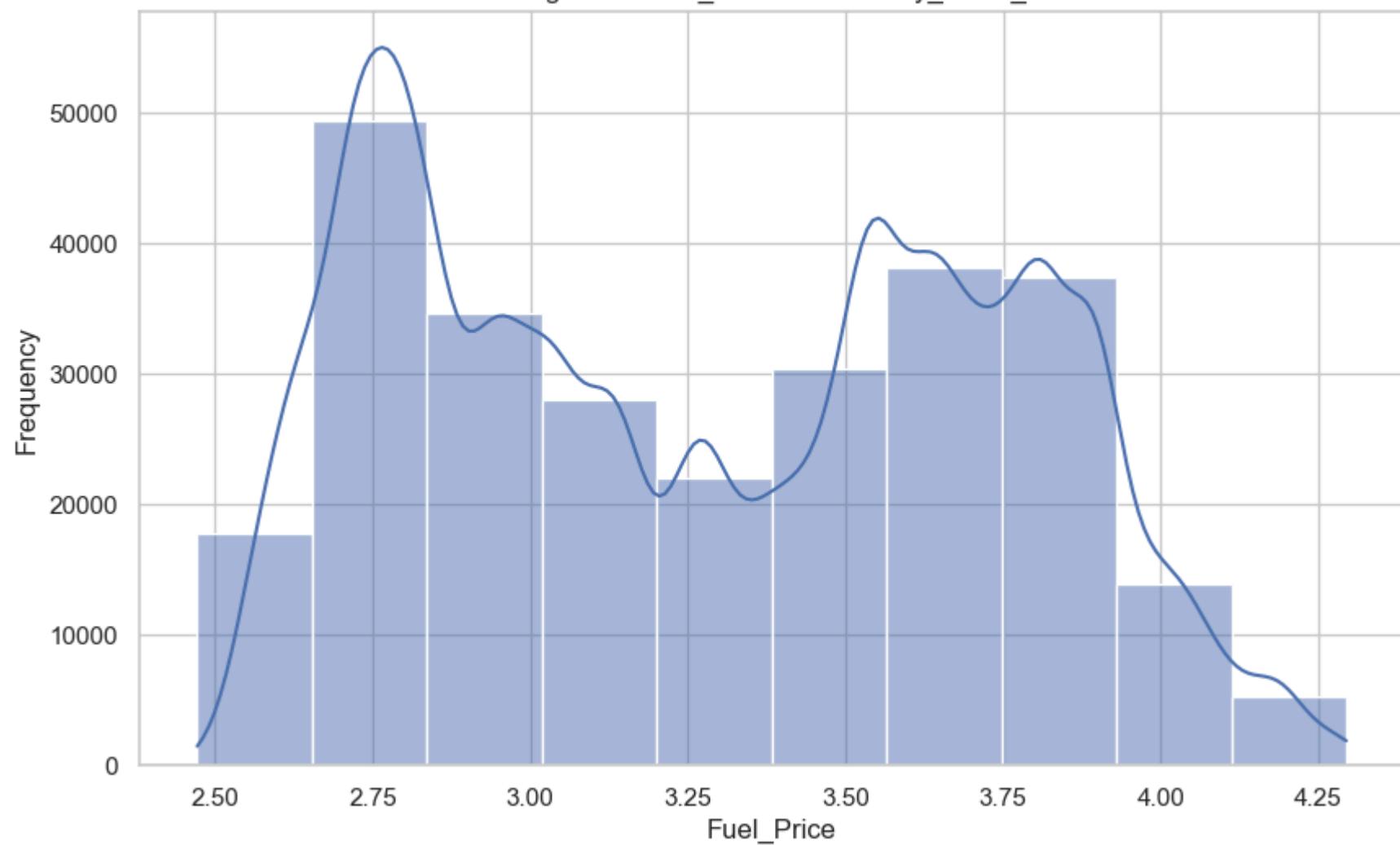


Box Plot of Temperature in Data with Weekly_Sales_7w

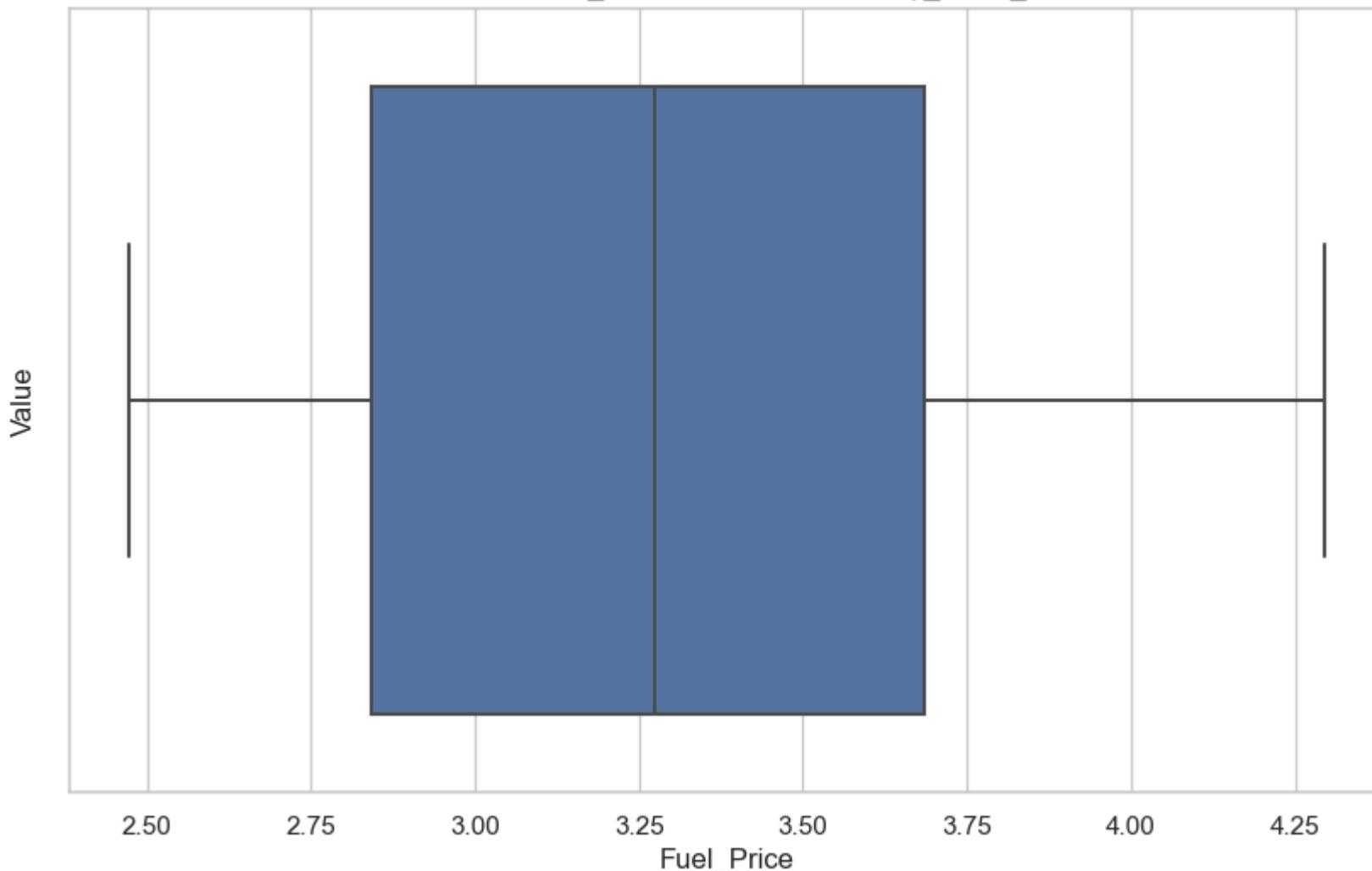


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Fuel_Price with Weekly_Sales_7w

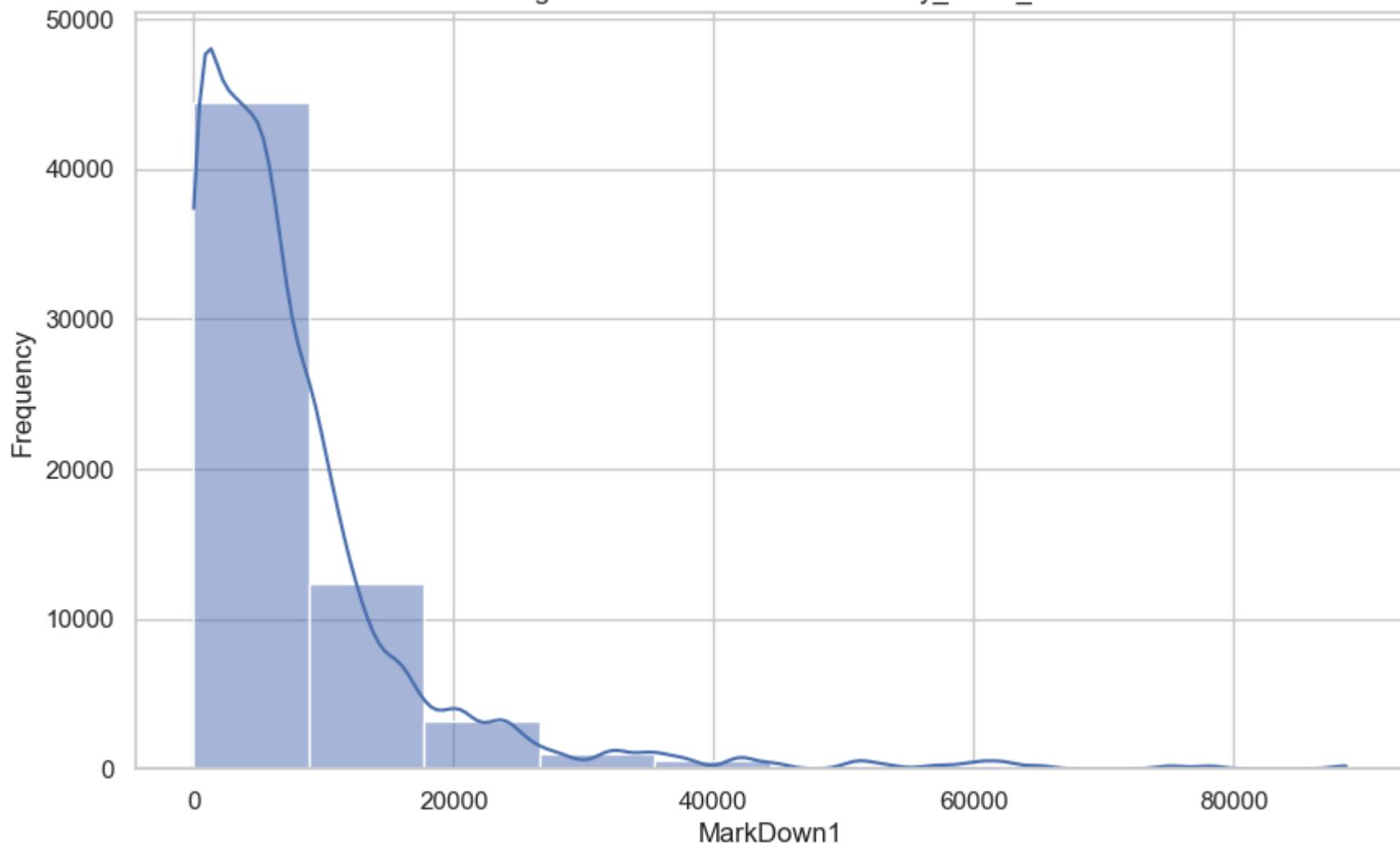


Box Plot of Fuel_Price in Data with Weekly_Sales_7w

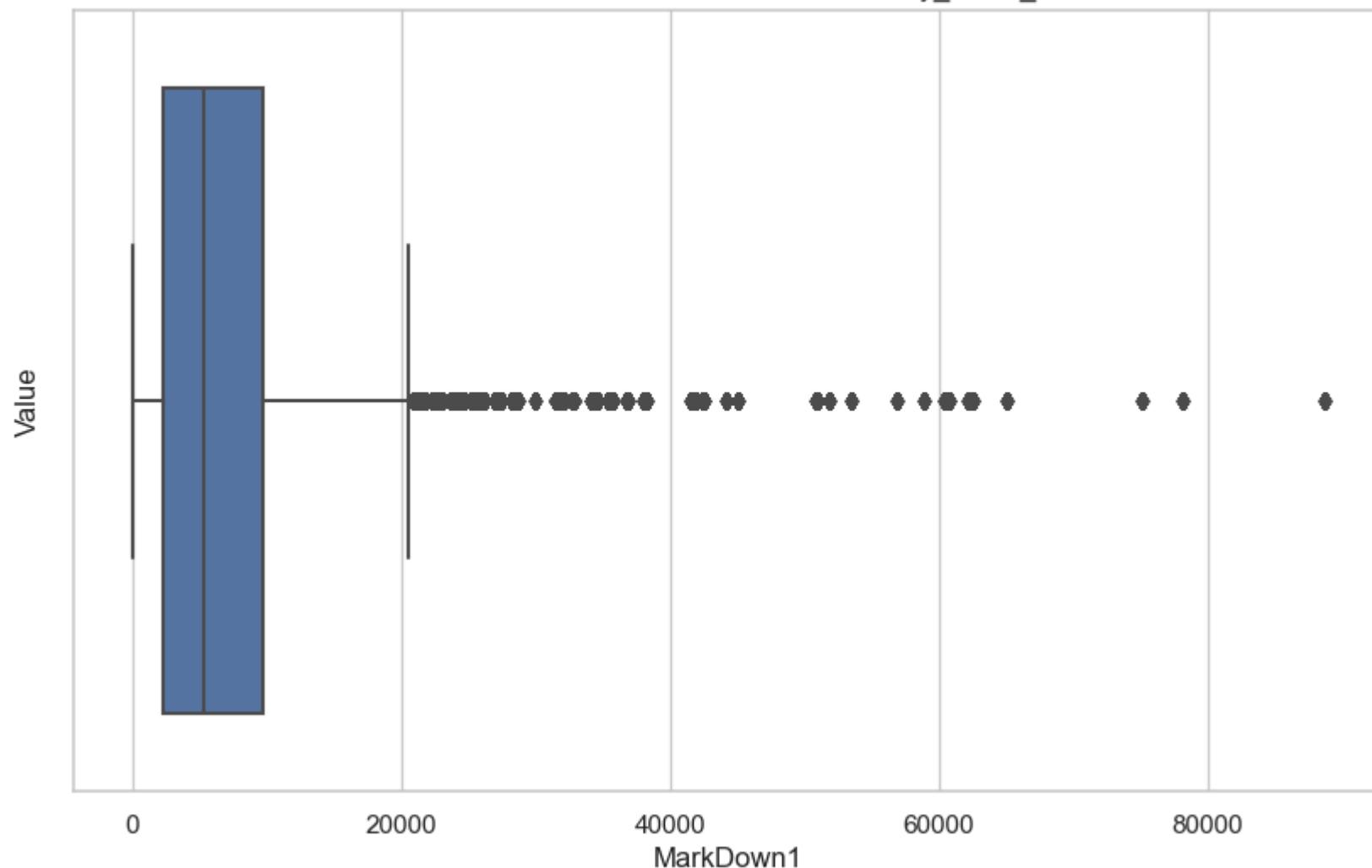


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown1 with Weekly_Sales_7w

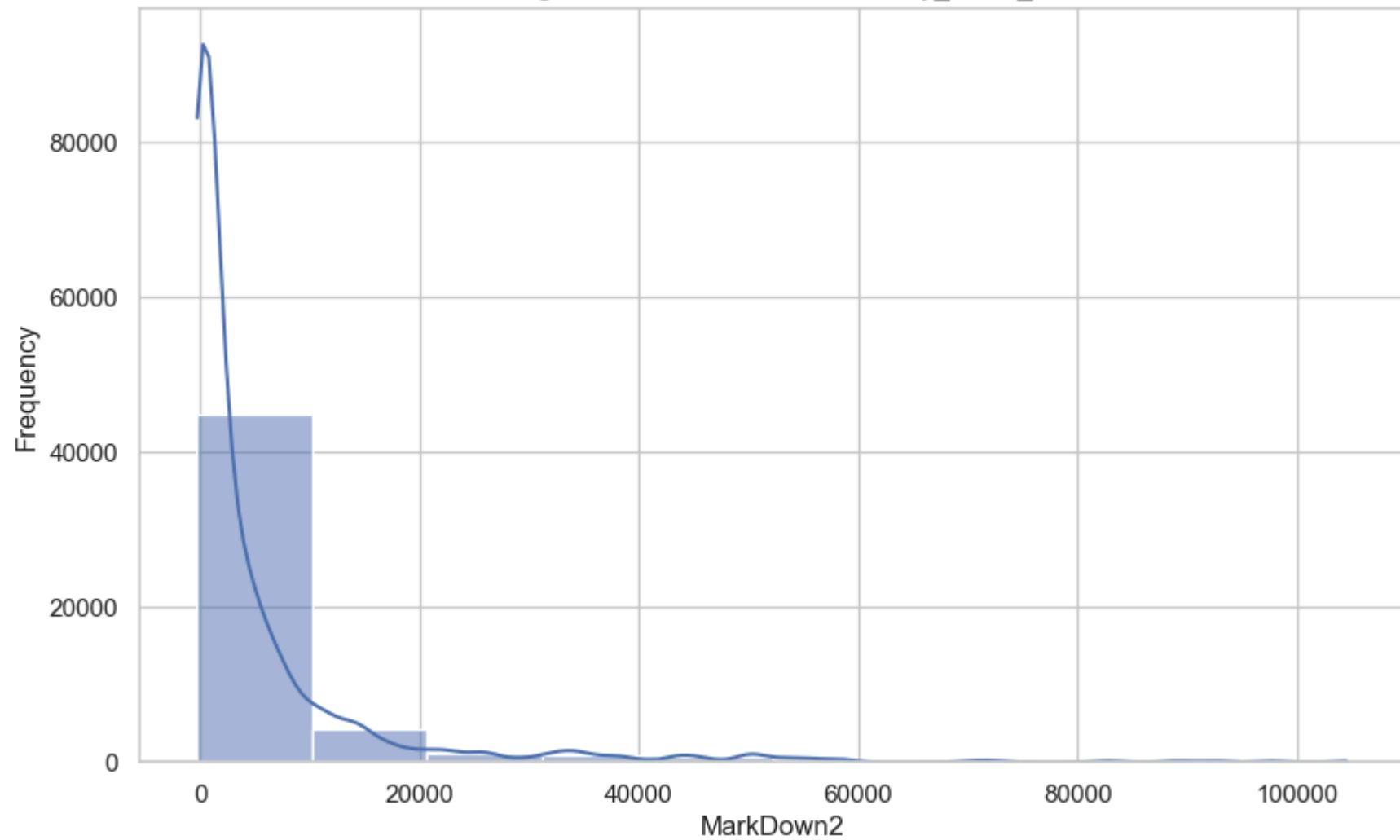


Box Plot of MarkDown1 in Data with Weekly_Sales_7w

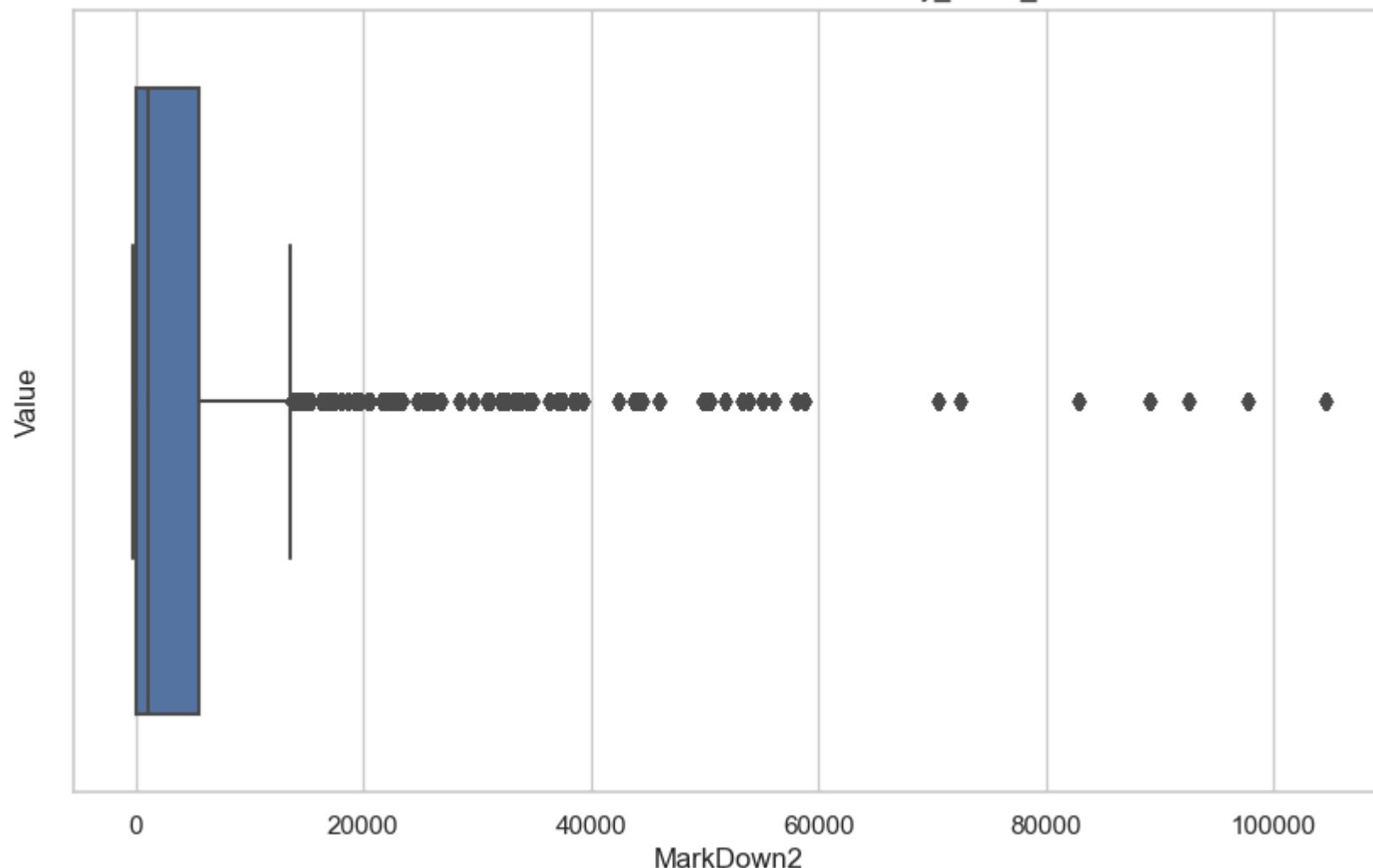


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_7w

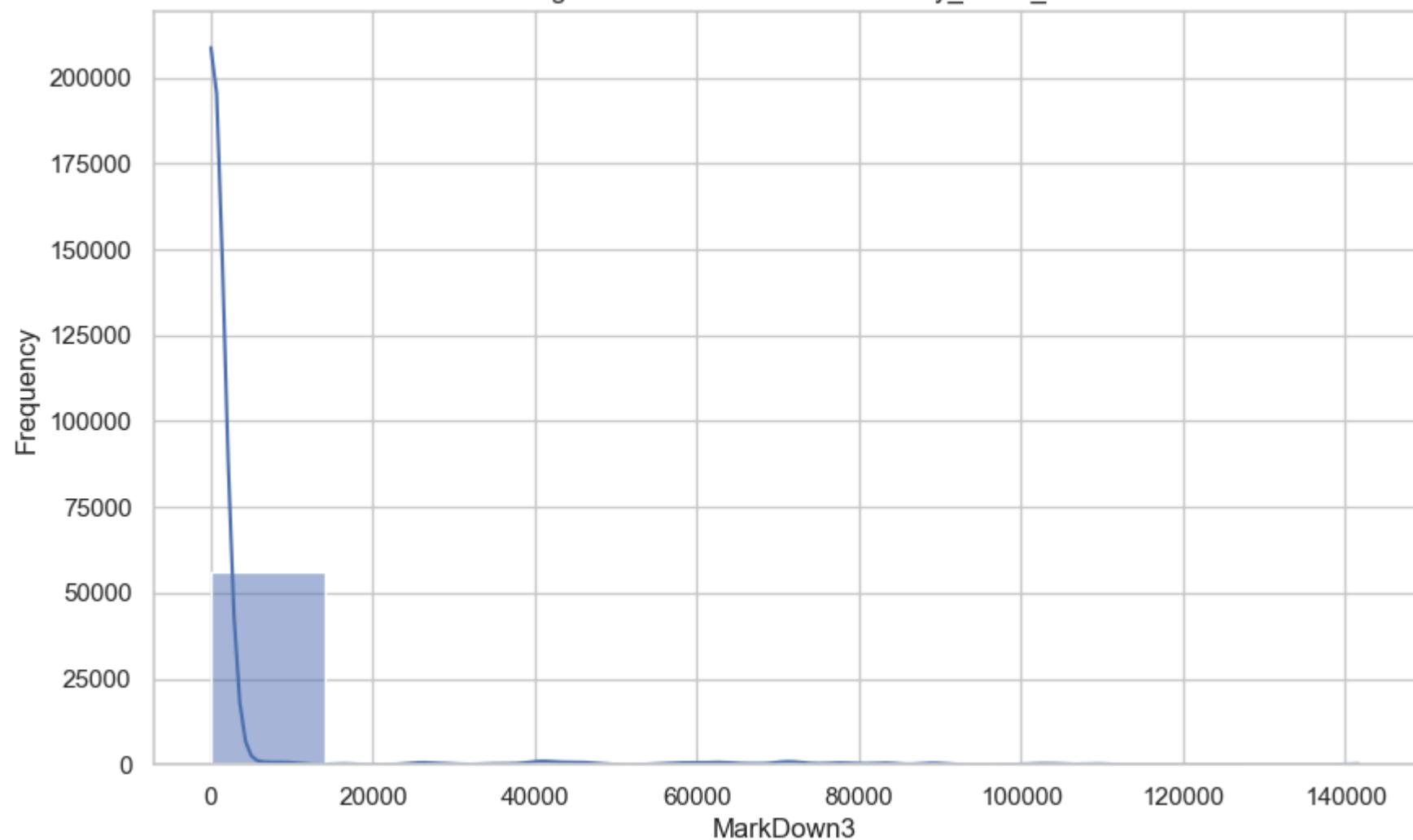


Box Plot of MarkDown2 in Data with Weekly_Sales_7w

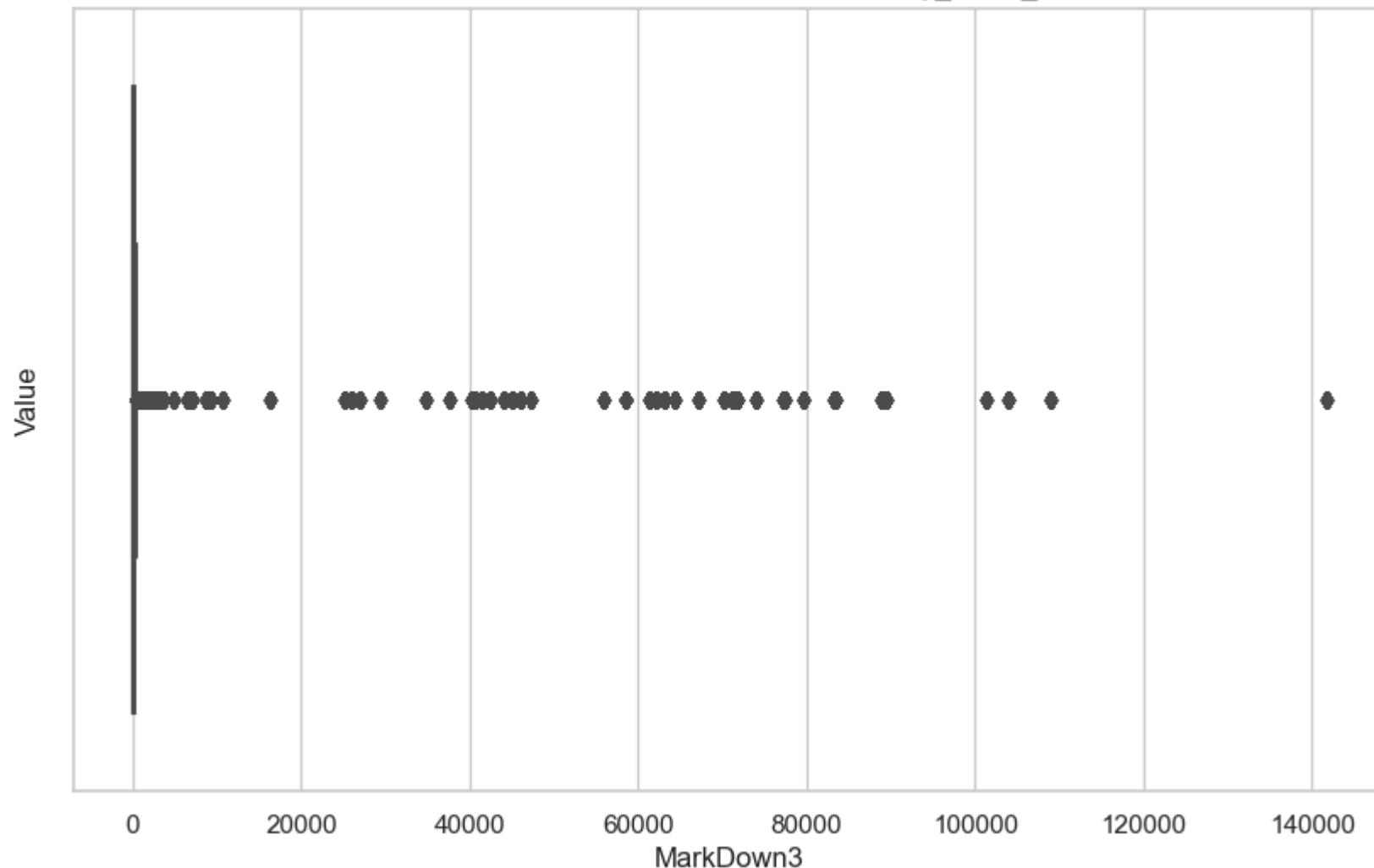


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_7w

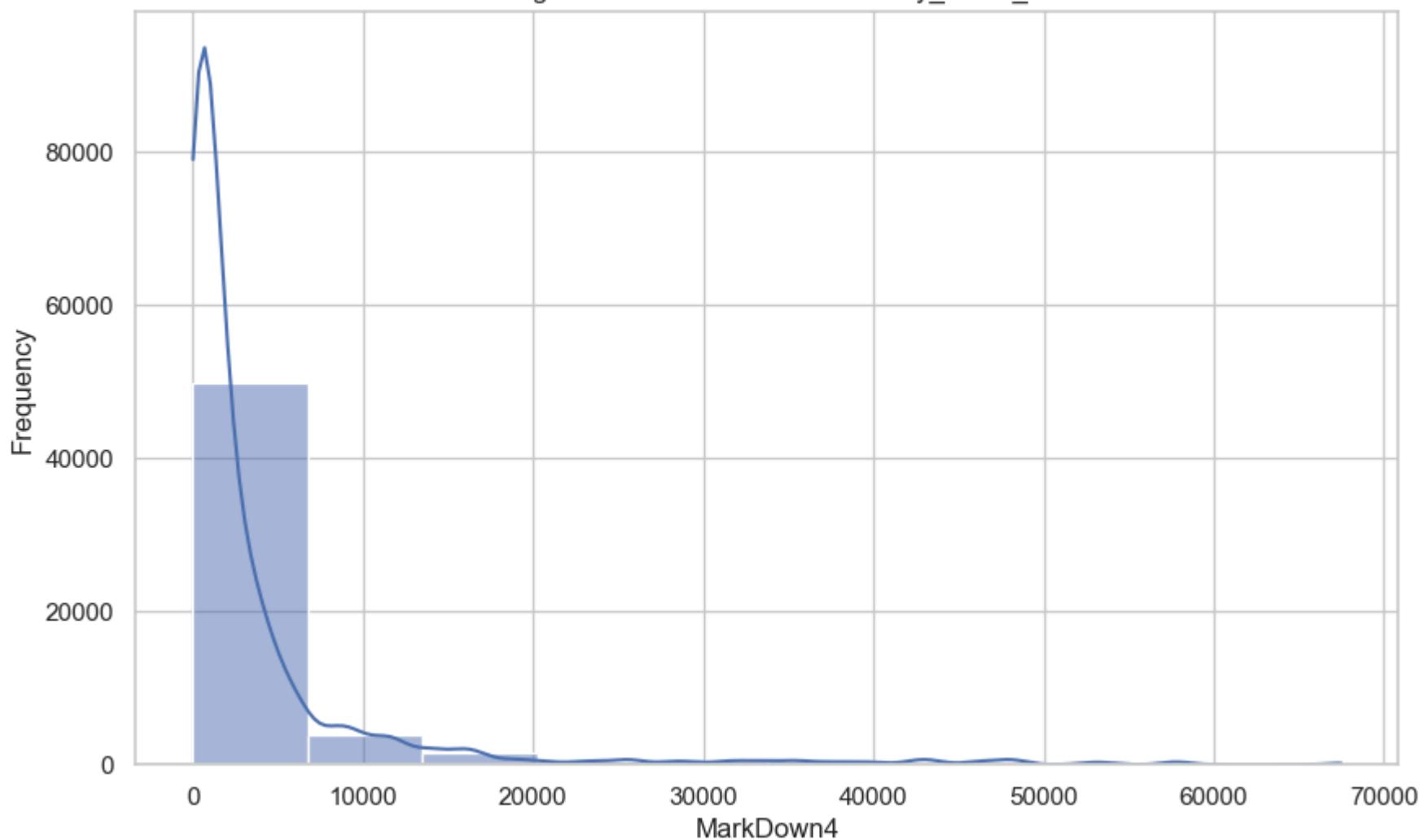


Box Plot of MarkDown3 in Data with Weekly_Sales_7w

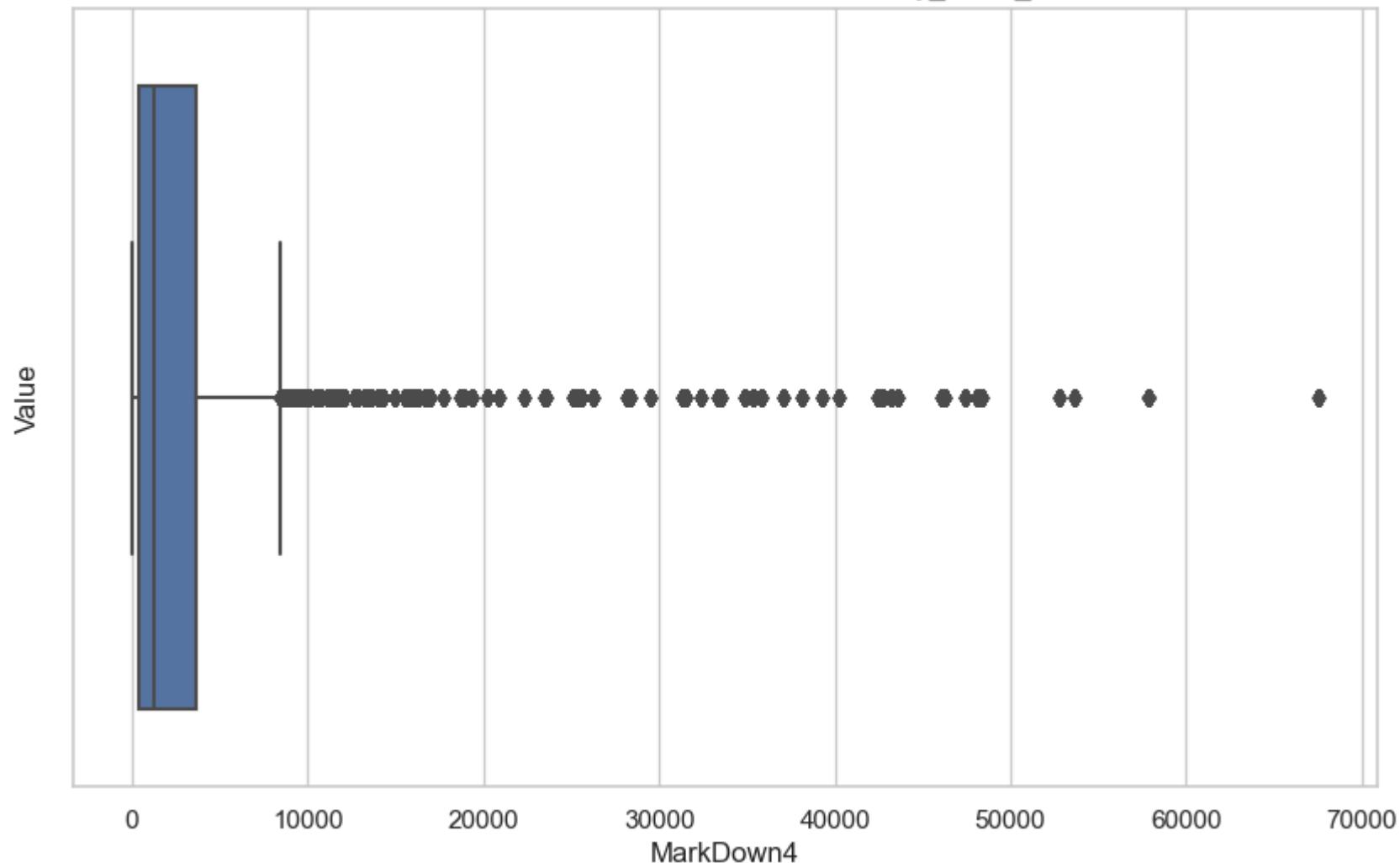


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_7w

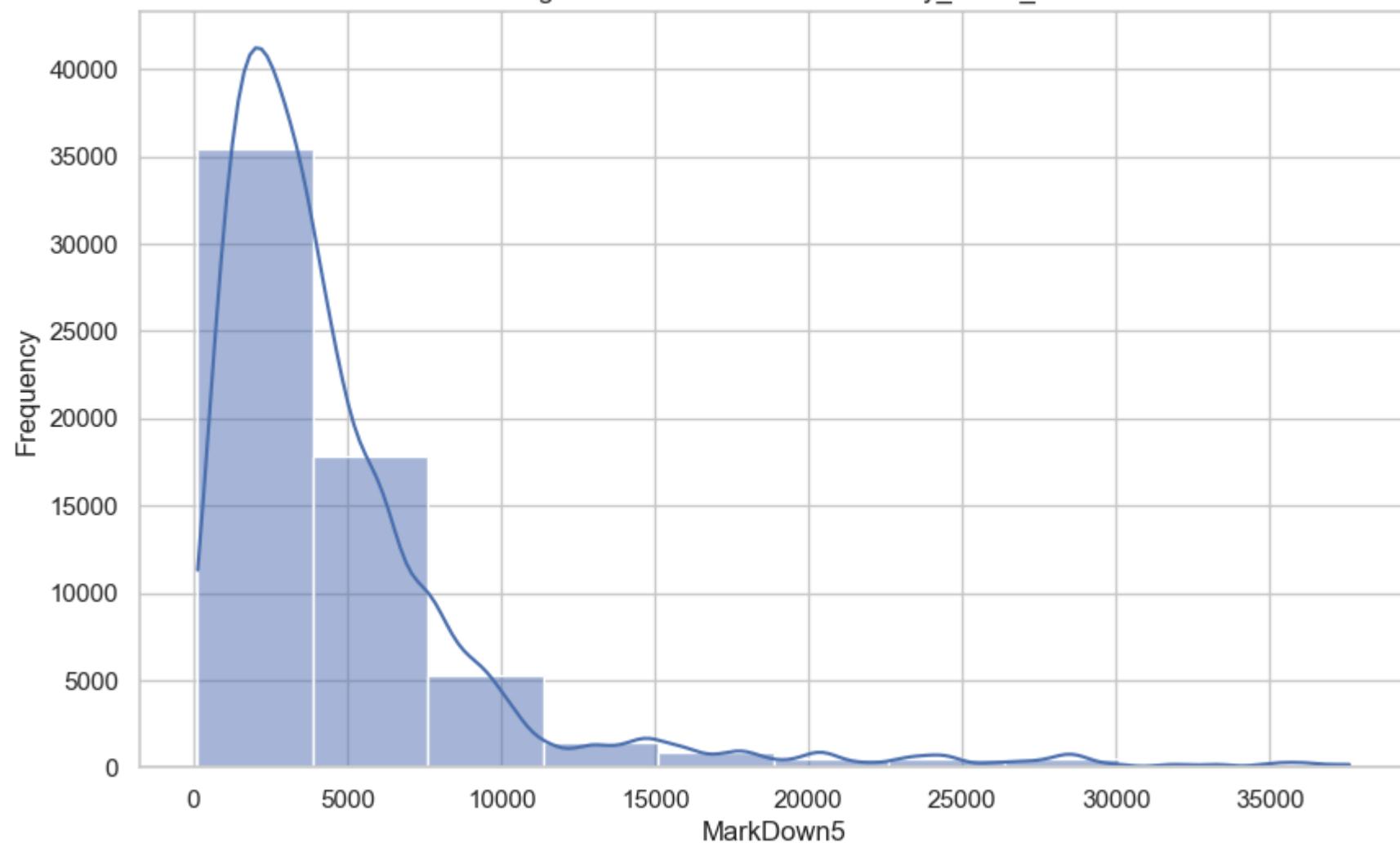


Box Plot of MarkDown4 in Data with Weekly_Sales_7w

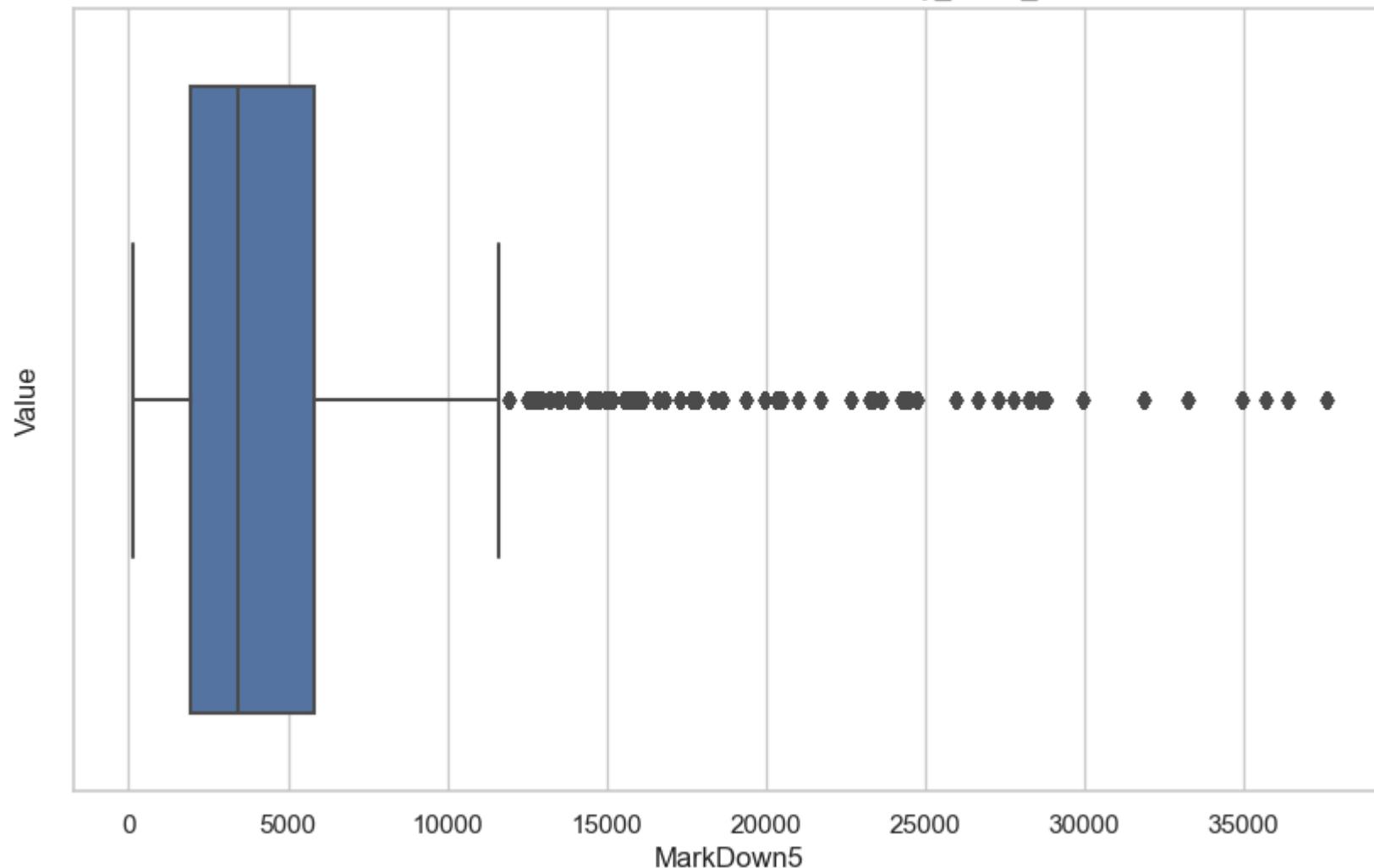


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_7w

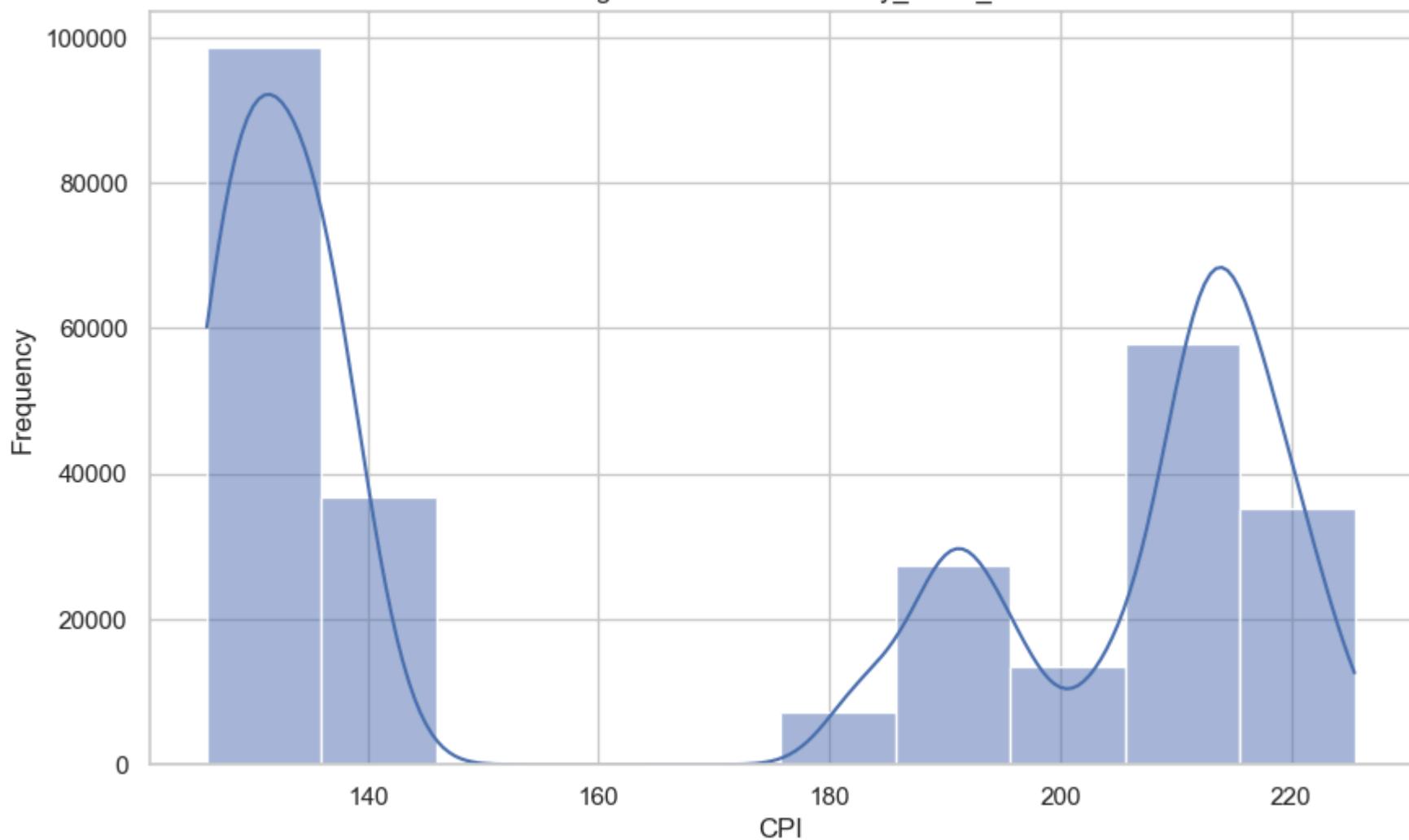


Box Plot of MarkDown5 in Data with Weekly_Sales_7w

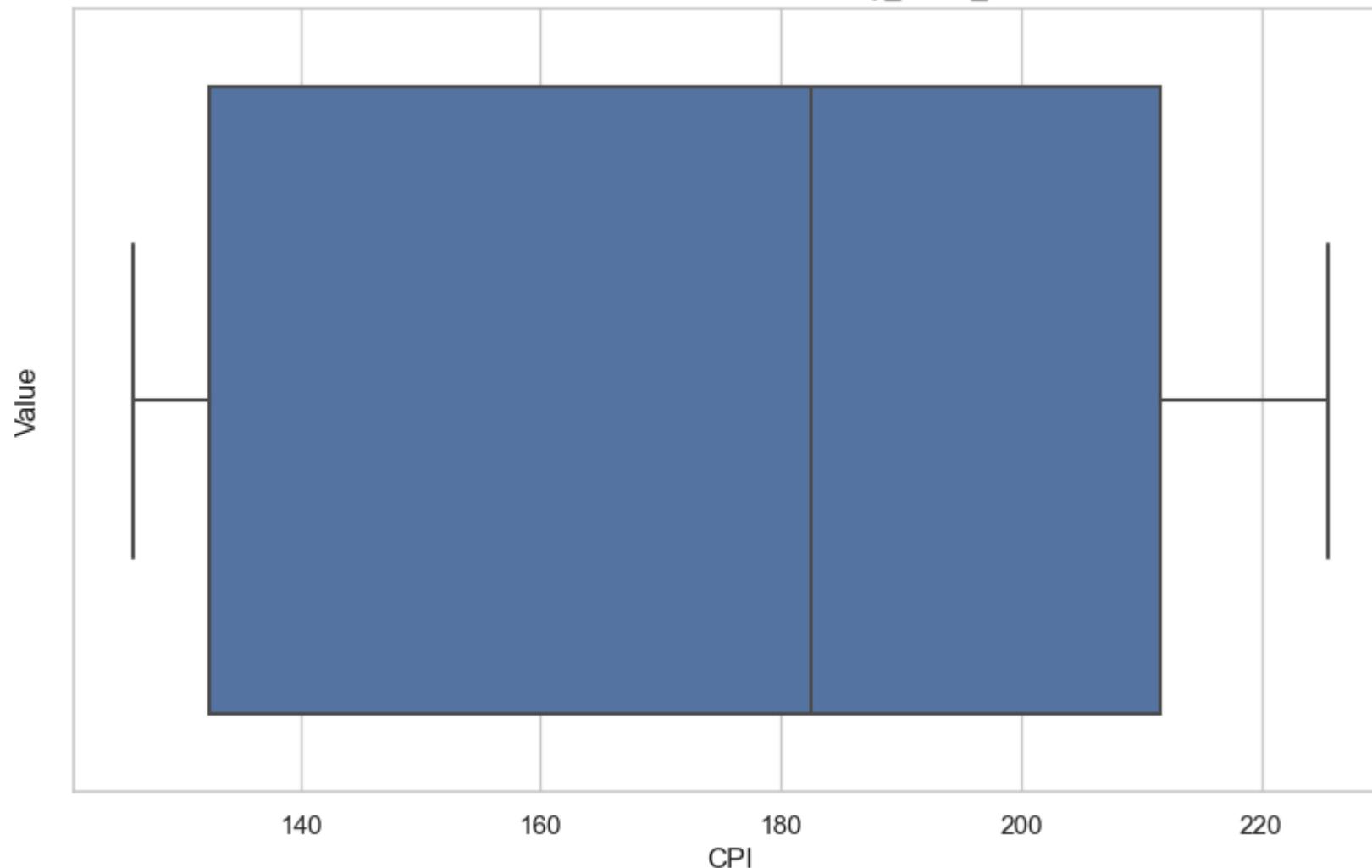


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_7w

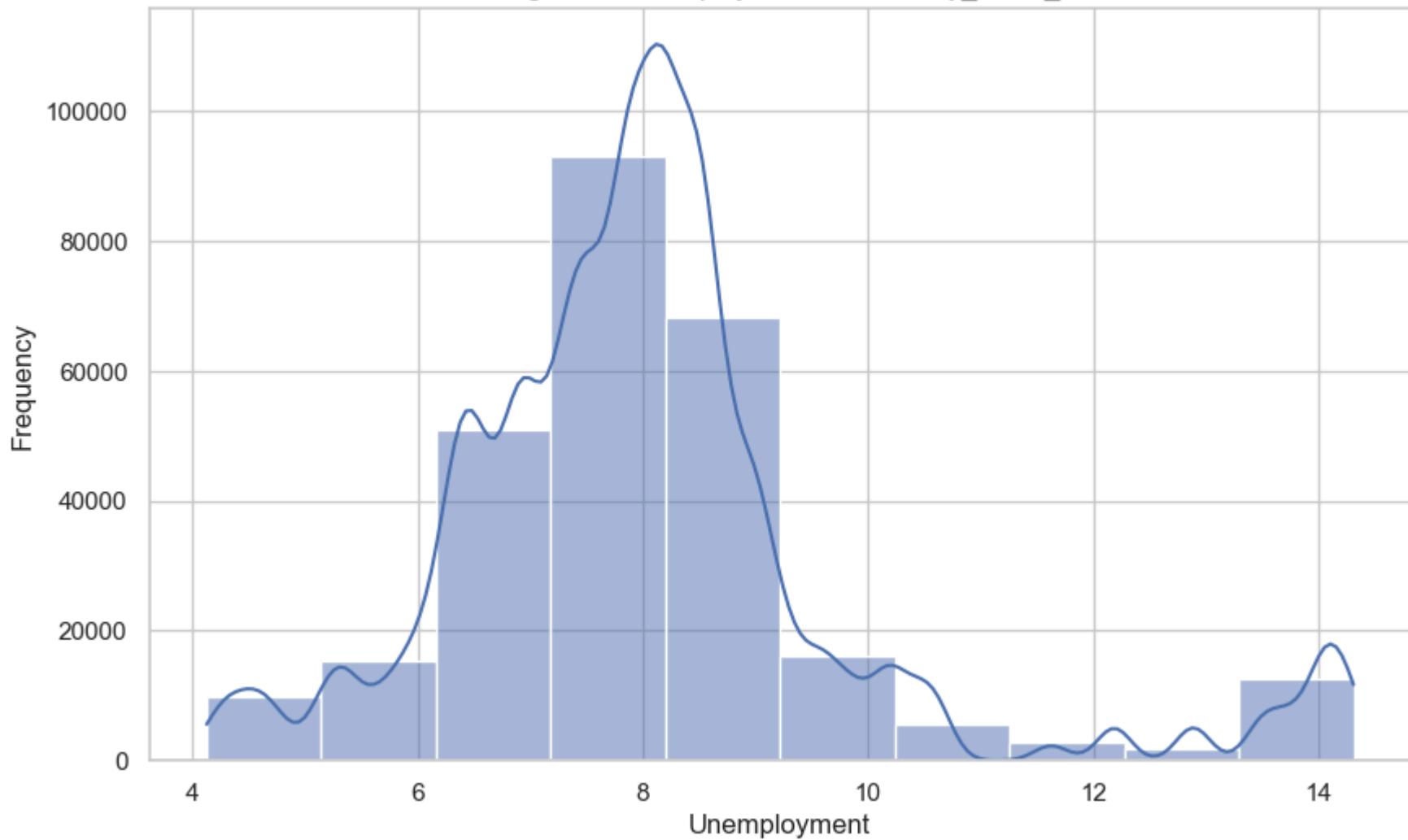


Box Plot of CPI in Data with Weekly_Sales_7w

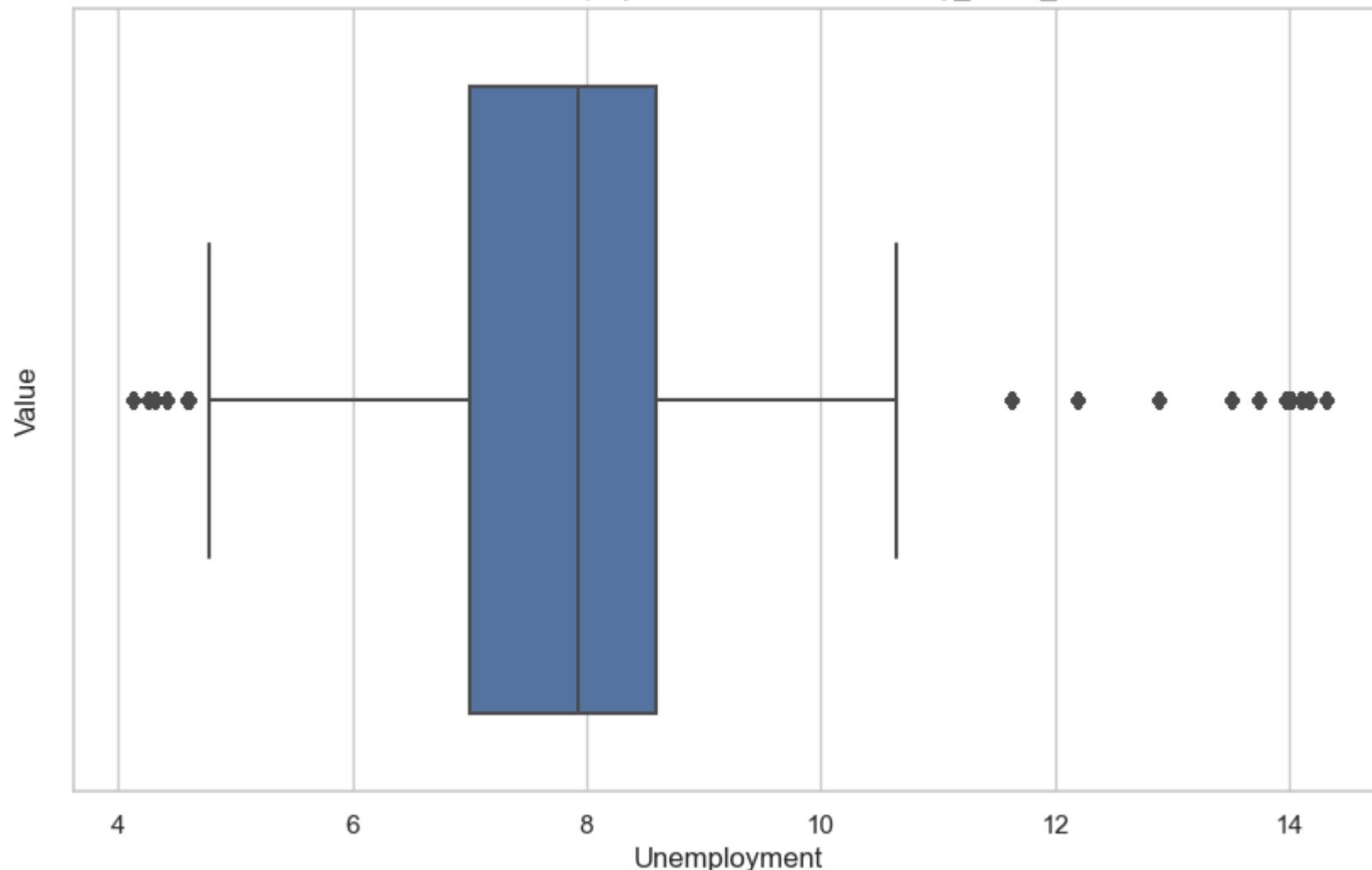


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_7w

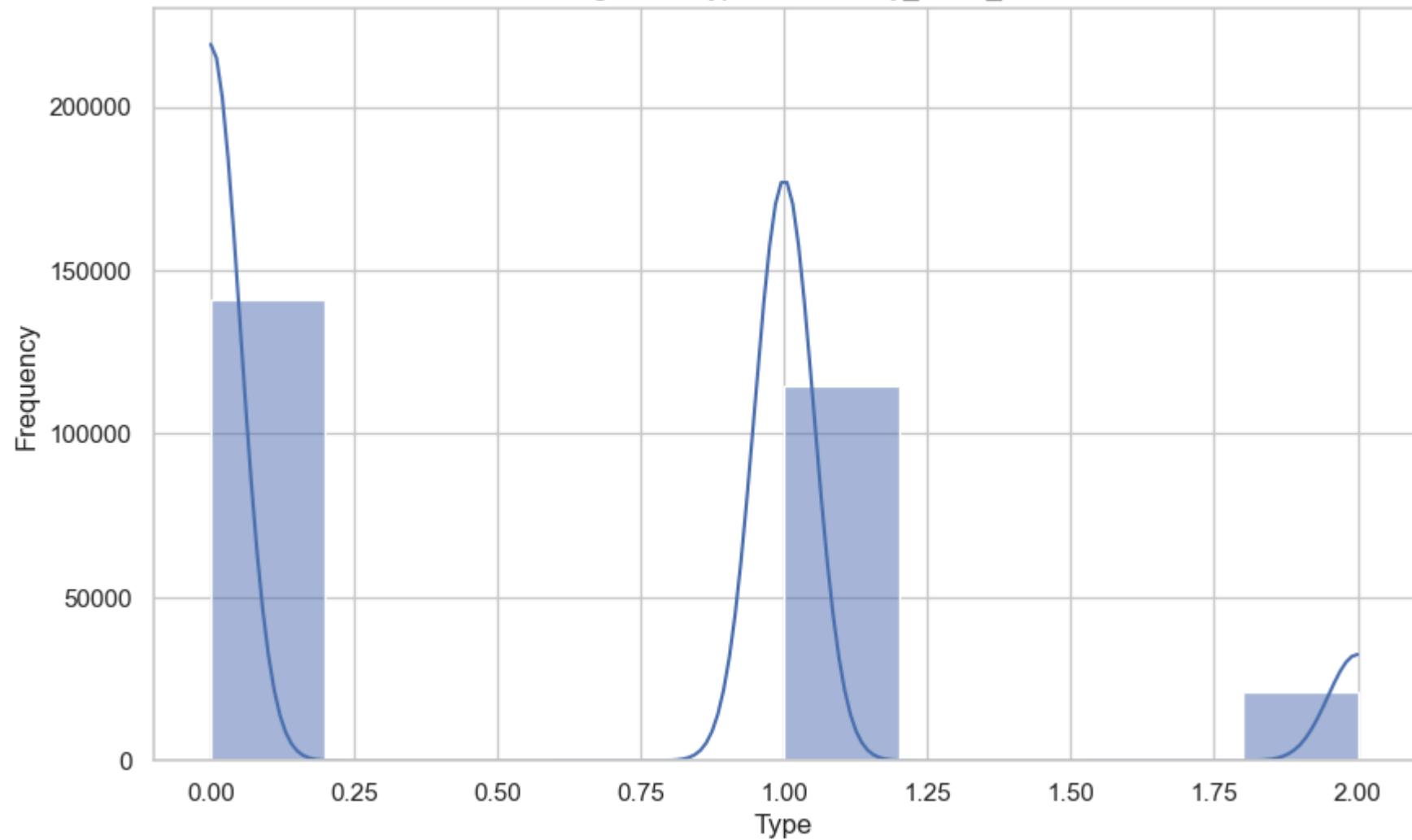


Box Plot of Unemployment in Data with Weekly_Sales_7w

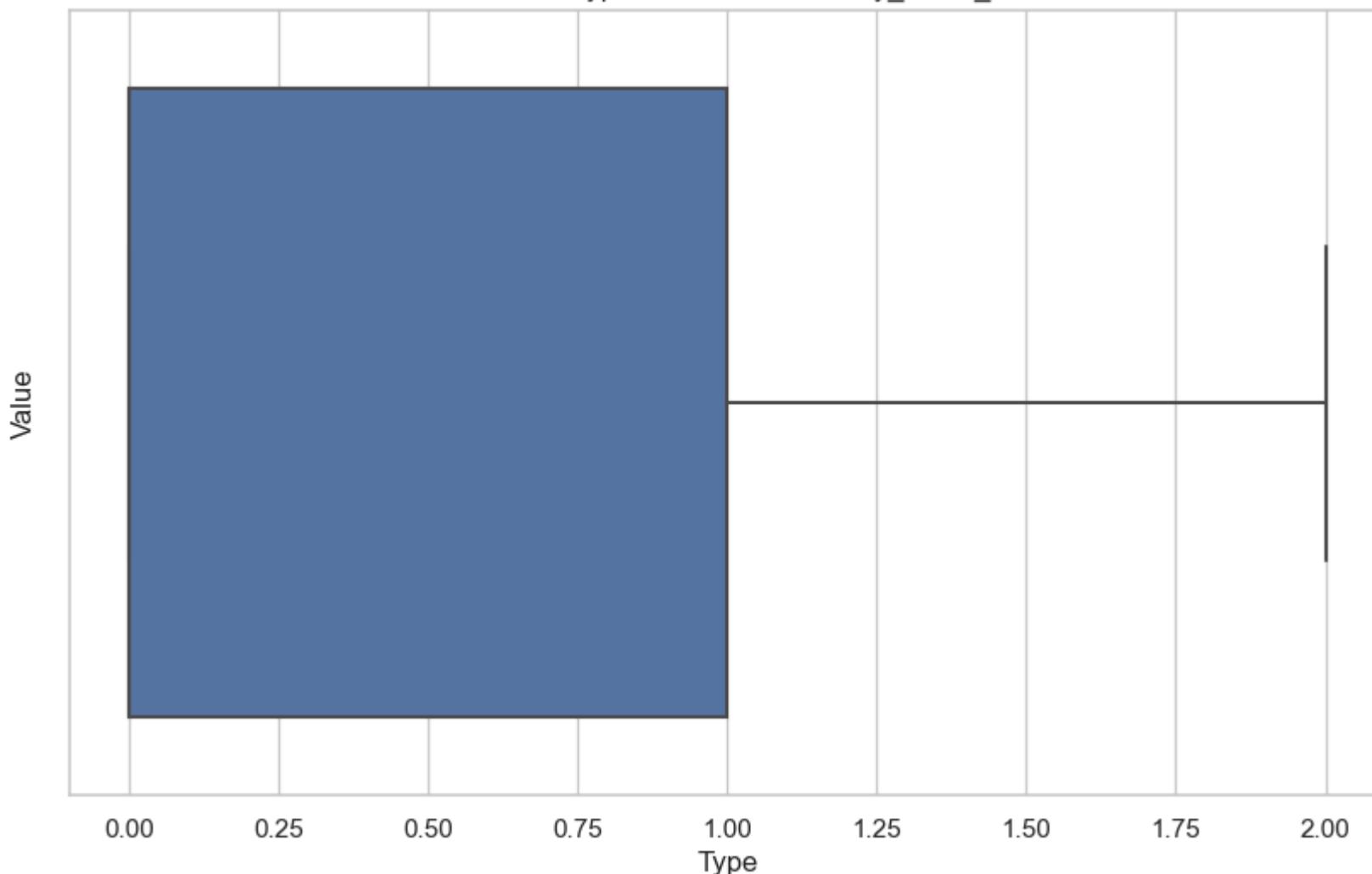


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_7w

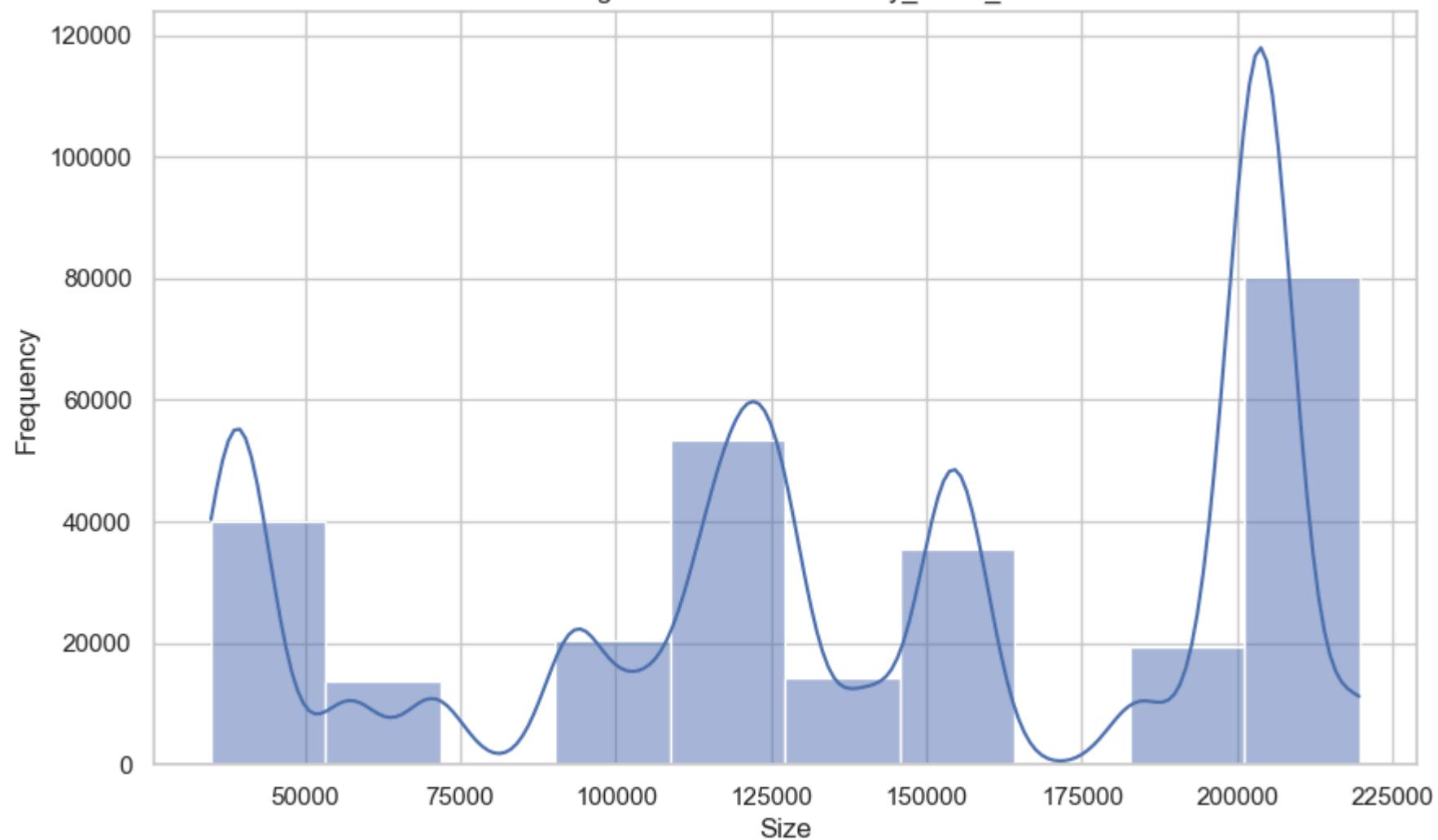


Box Plot of Type in Data with Weekly_Sales_7w

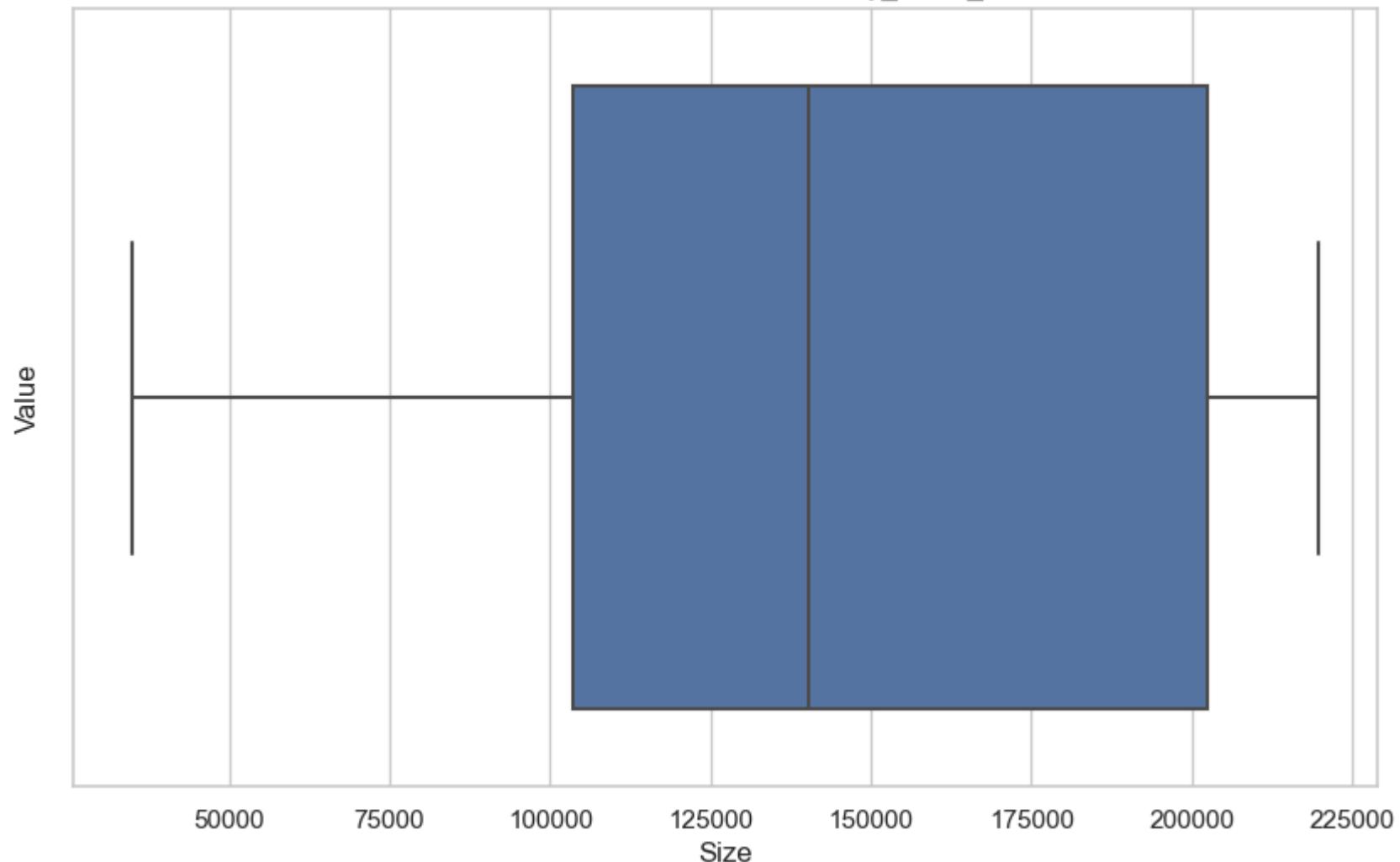


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_7w

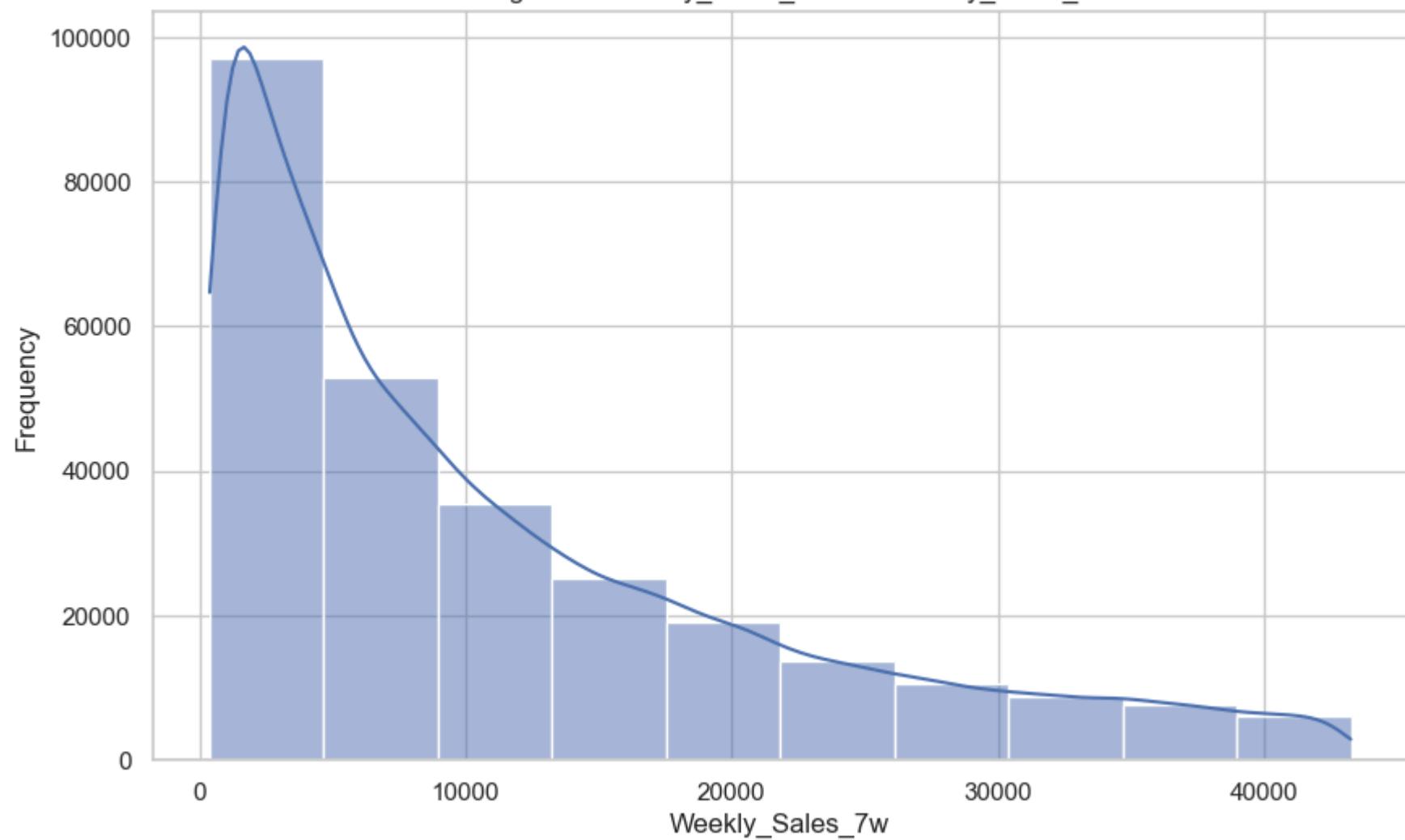


Box Plot of Size in Data with Weekly_Sales_7w

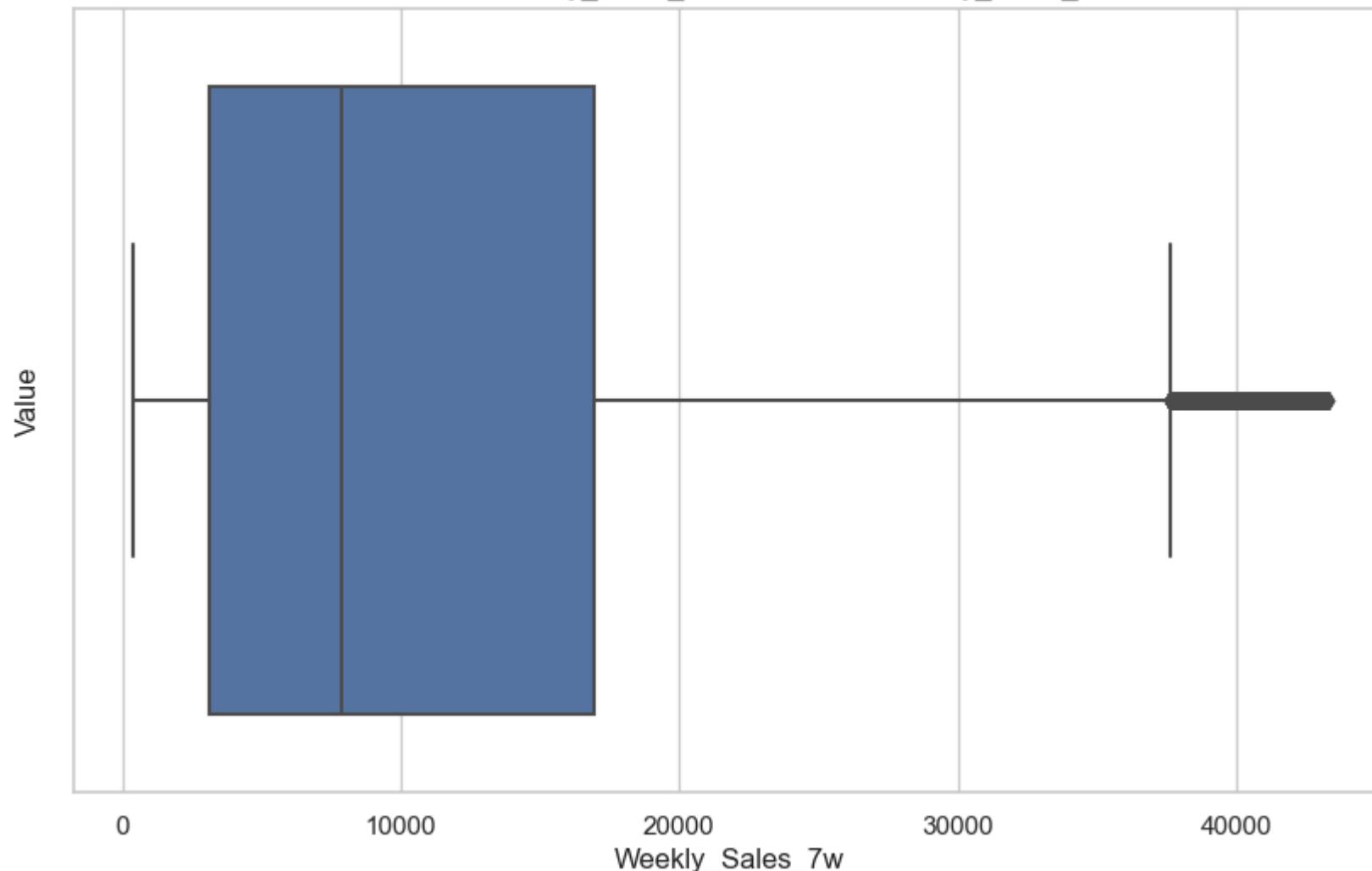


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_7w with Weekly_Sales_7w

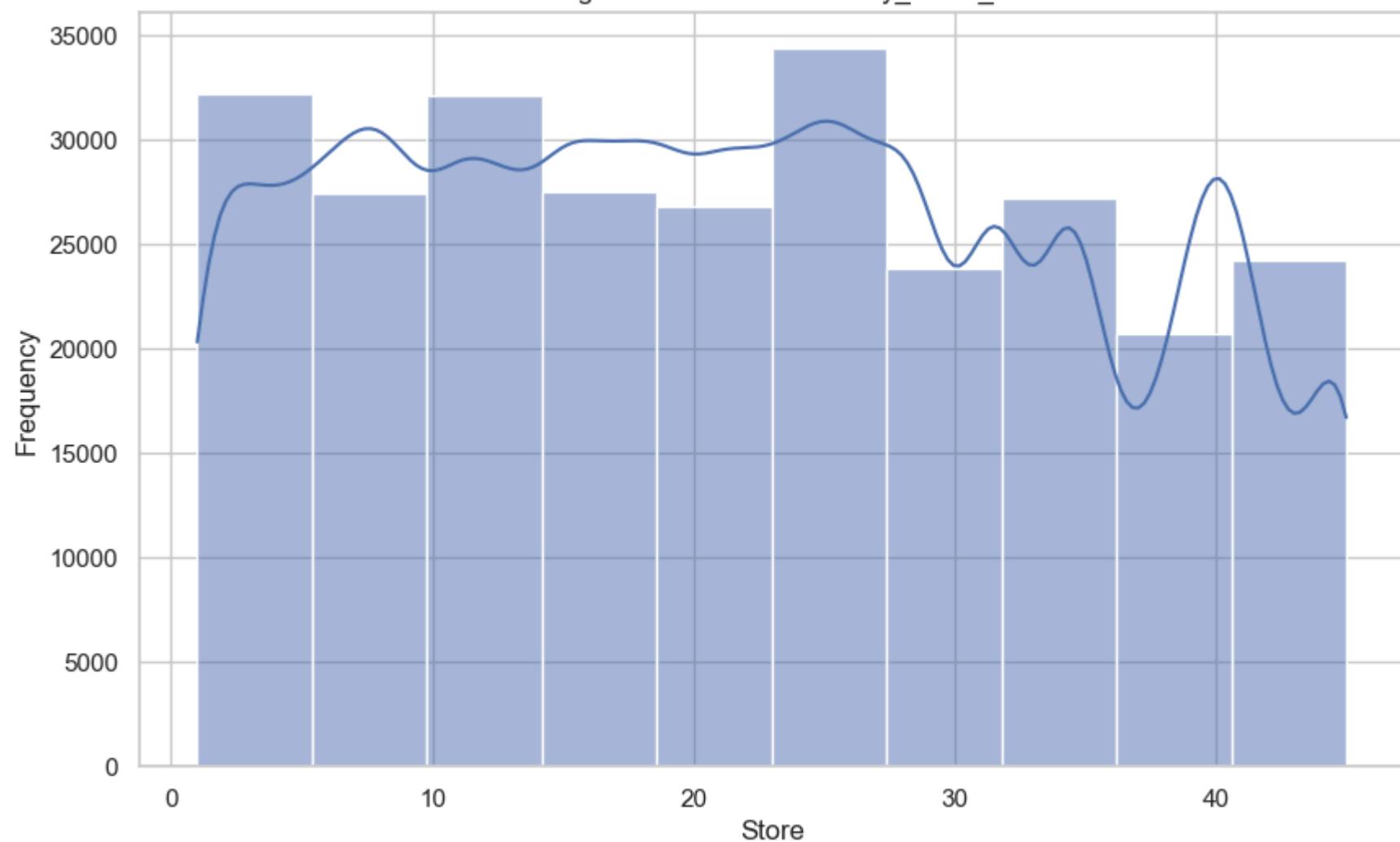


Box Plot of Weekly_Sales_7w in Data with Weekly_Sales_7w

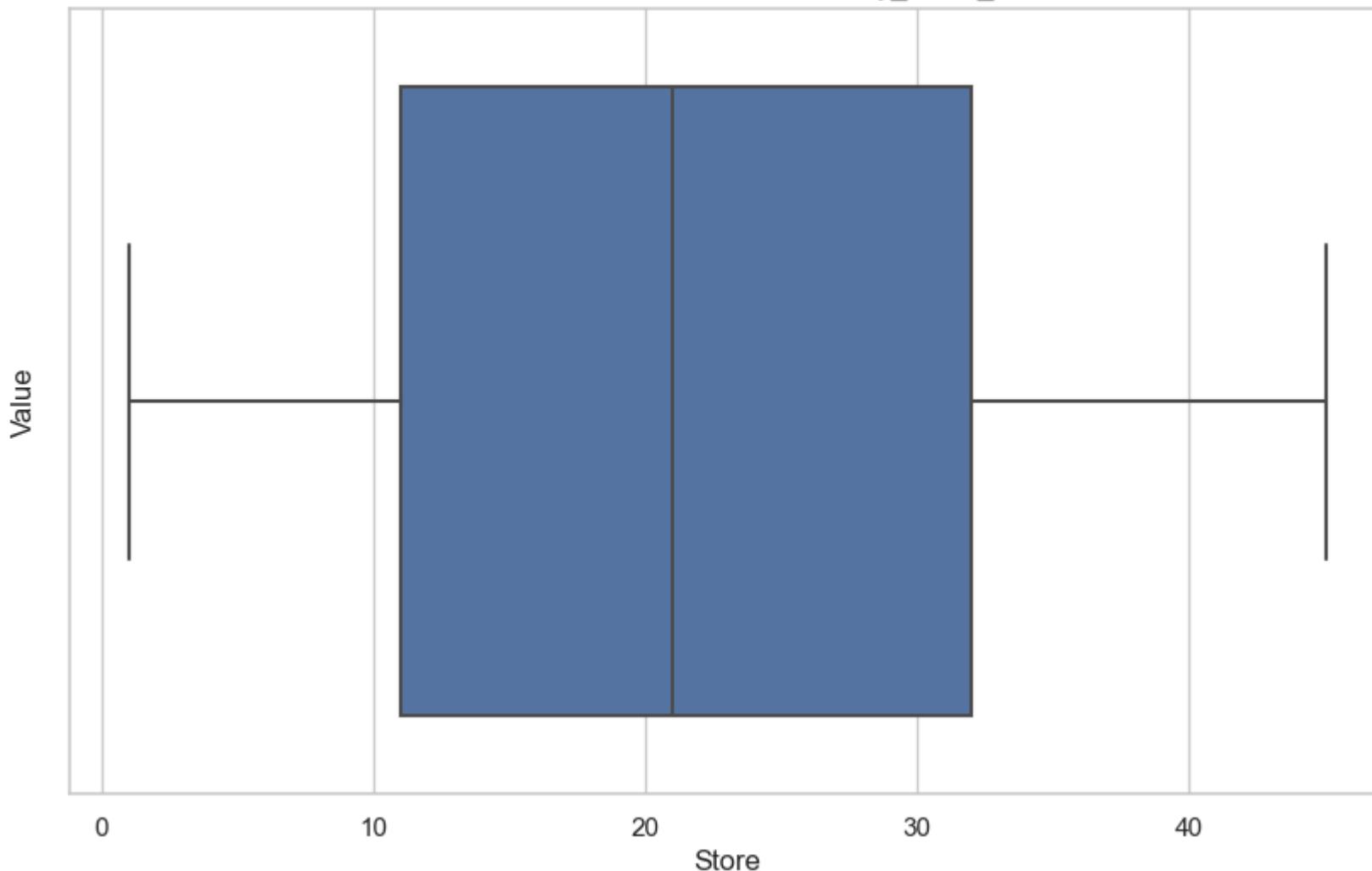


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_8w

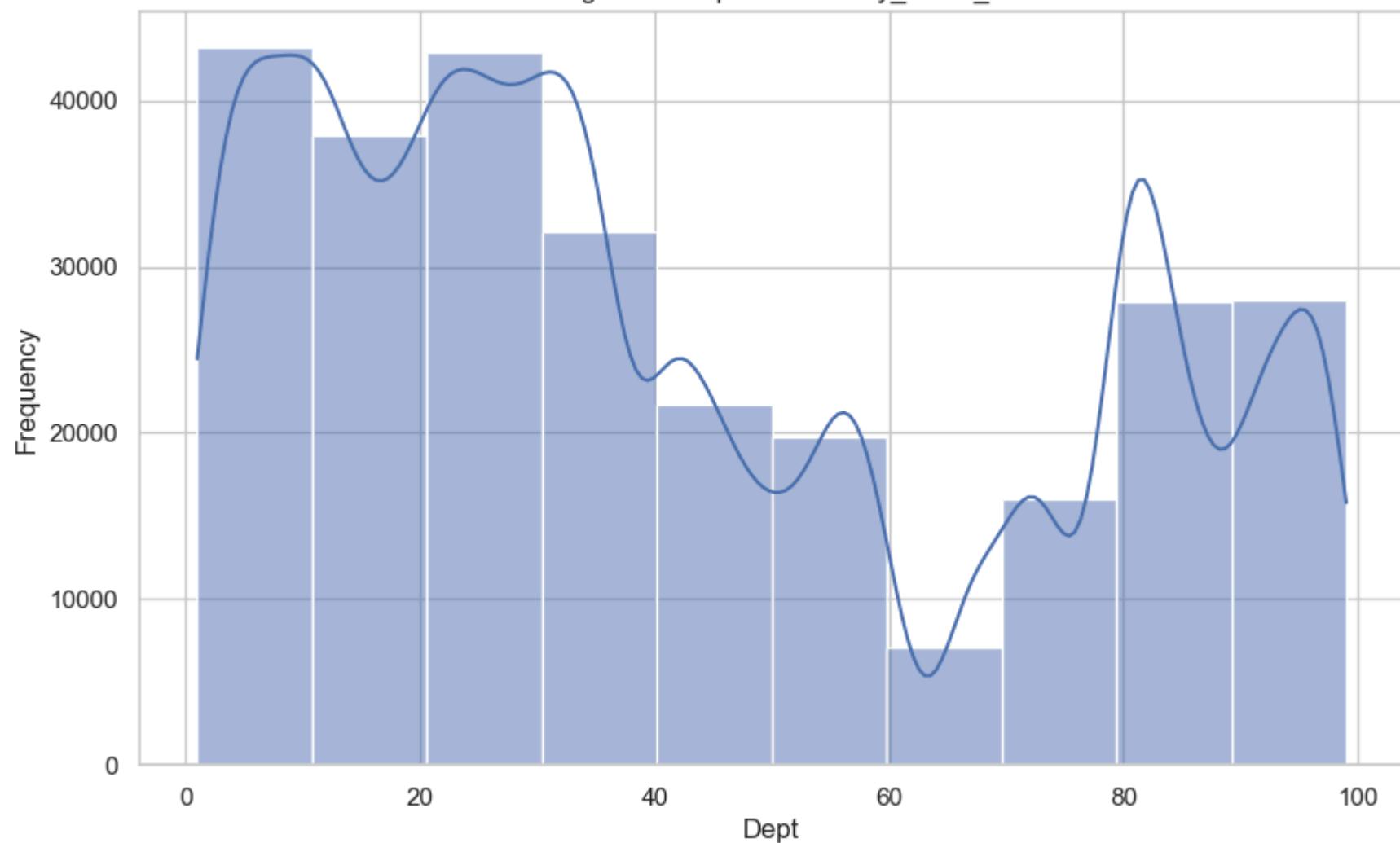


Box Plot of Store in Data with Weekly_Sales_8w

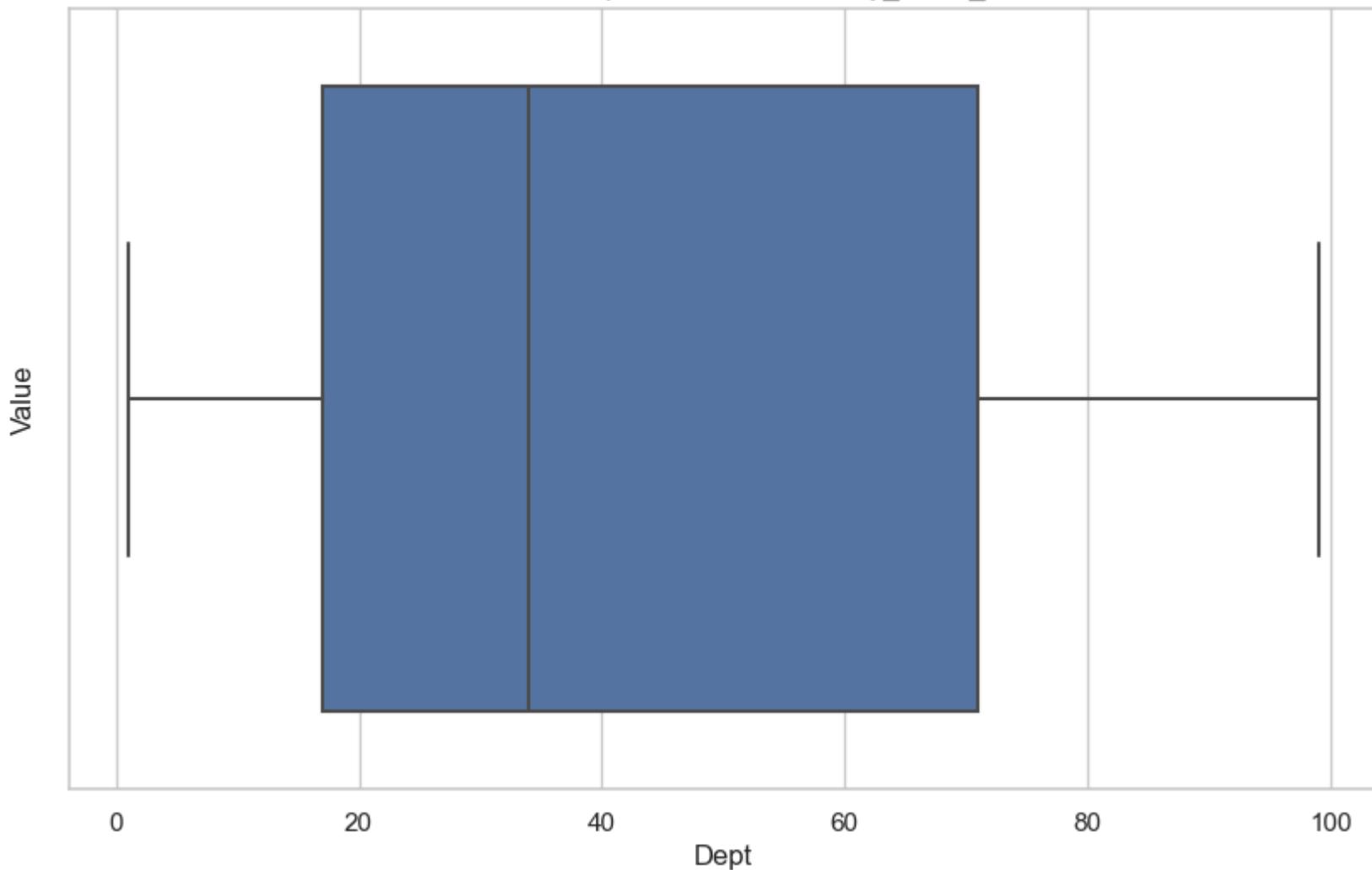


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_8w

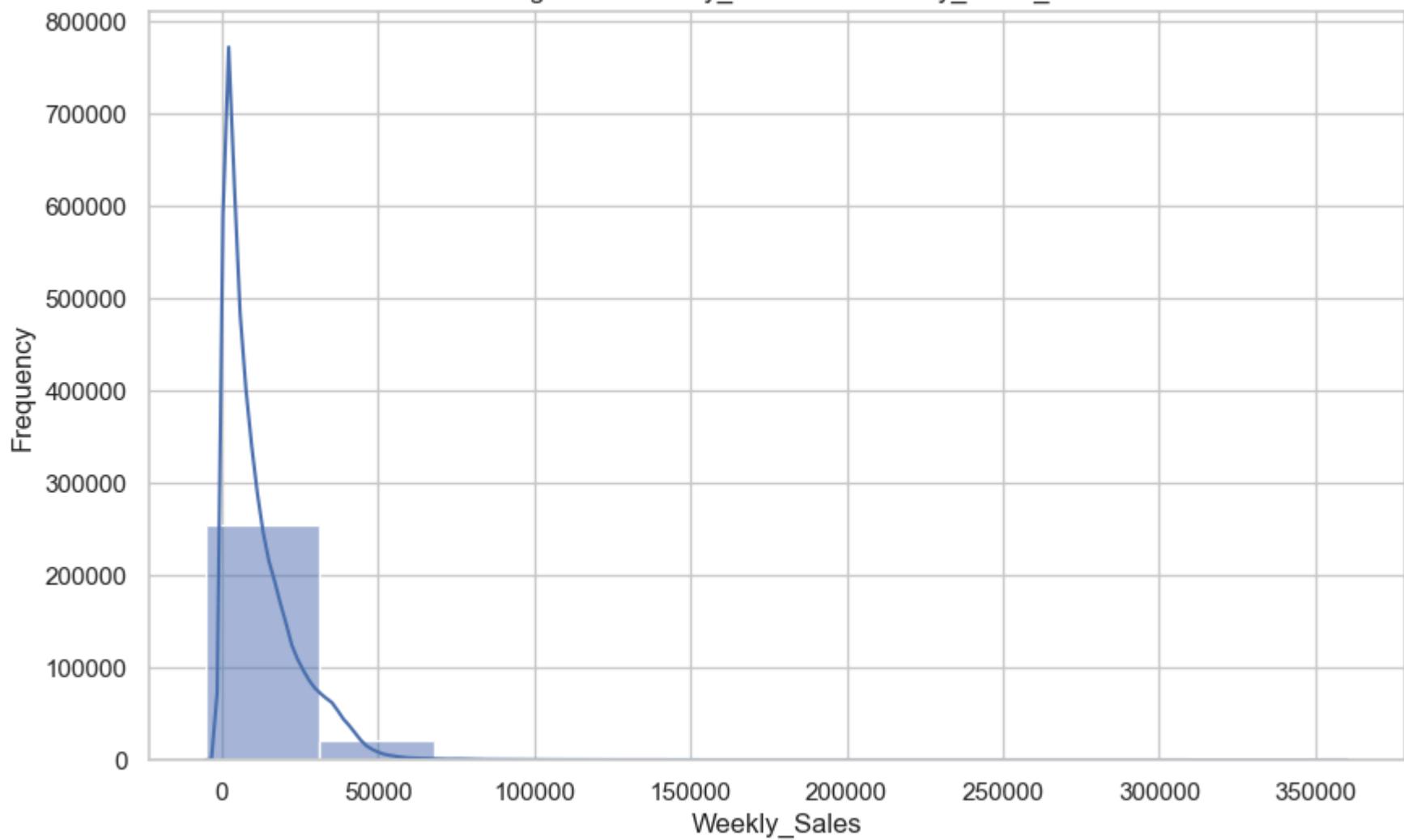


Box Plot of Dept in Data with Weekly_Sales_8w

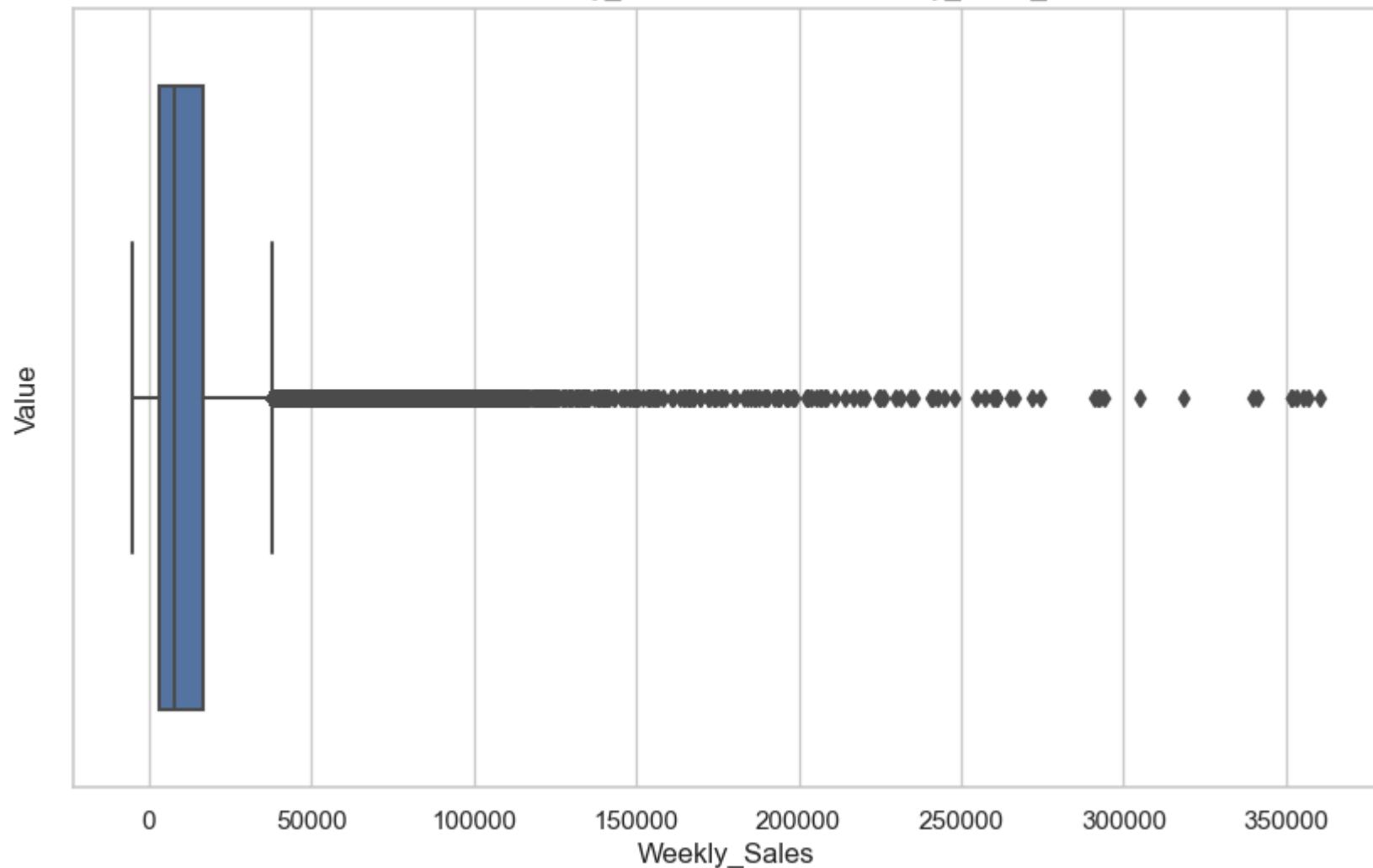


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_8w

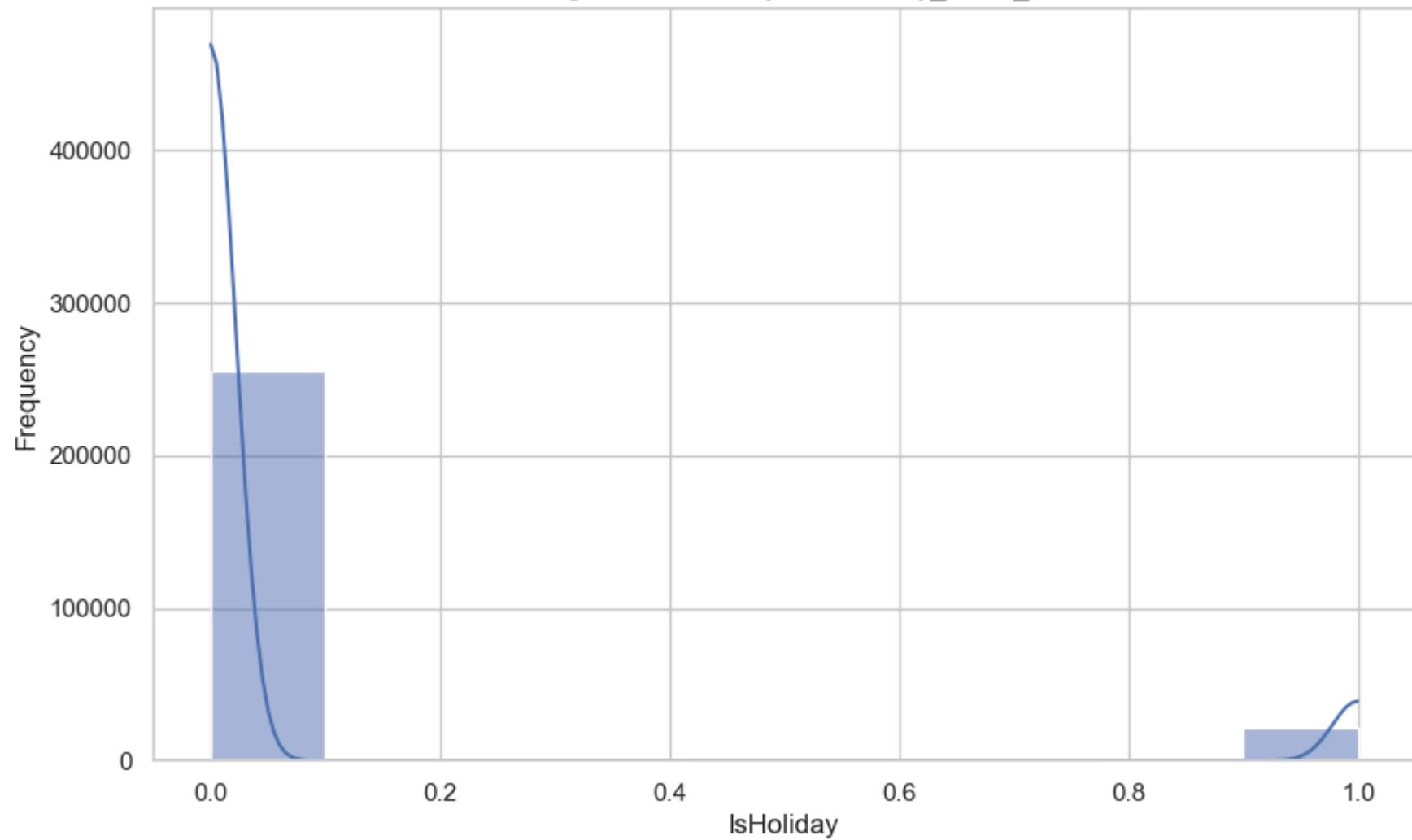


Box Plot of Weekly_Sales in Data with Weekly_Sales_8w

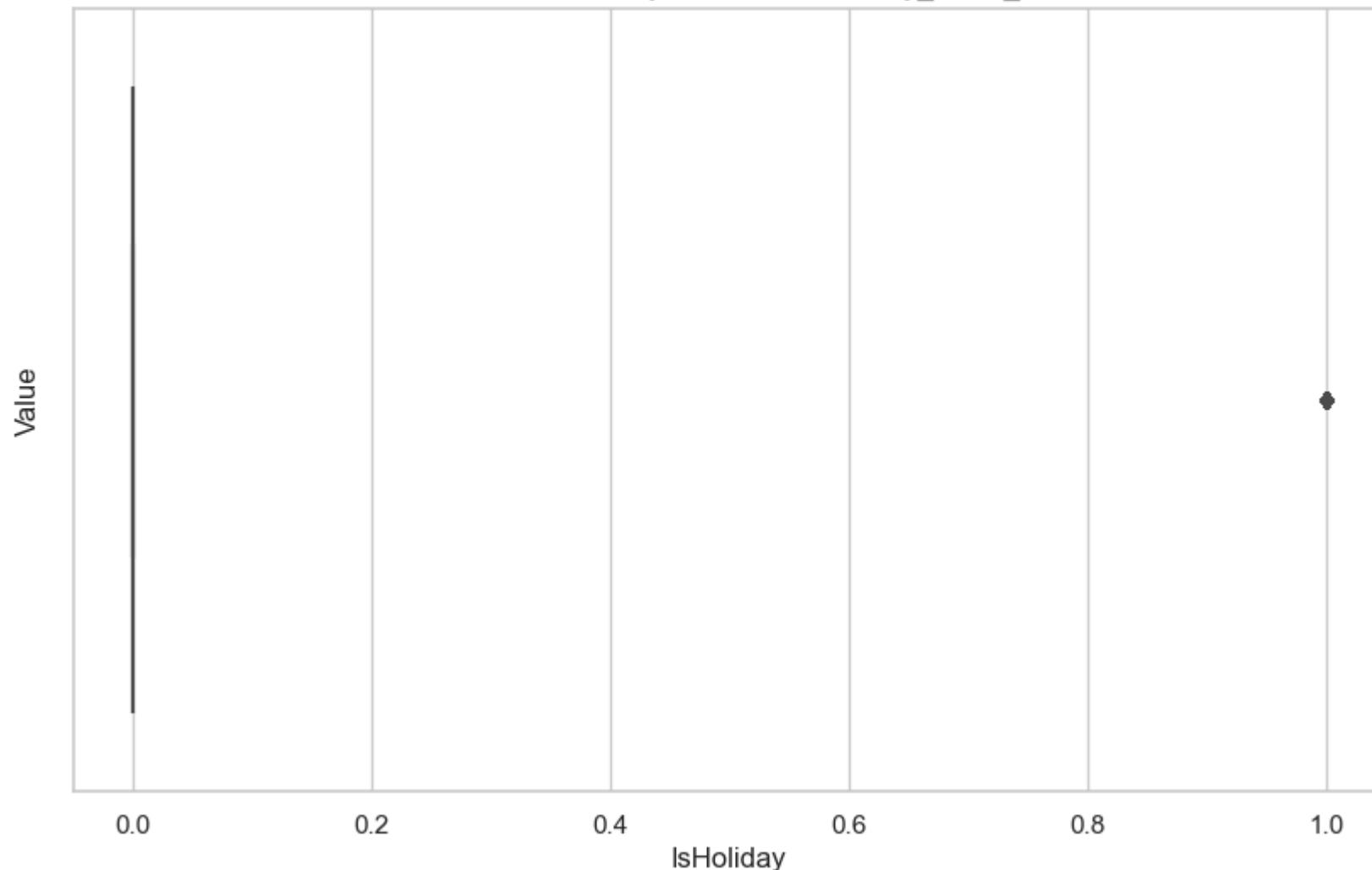


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_8w

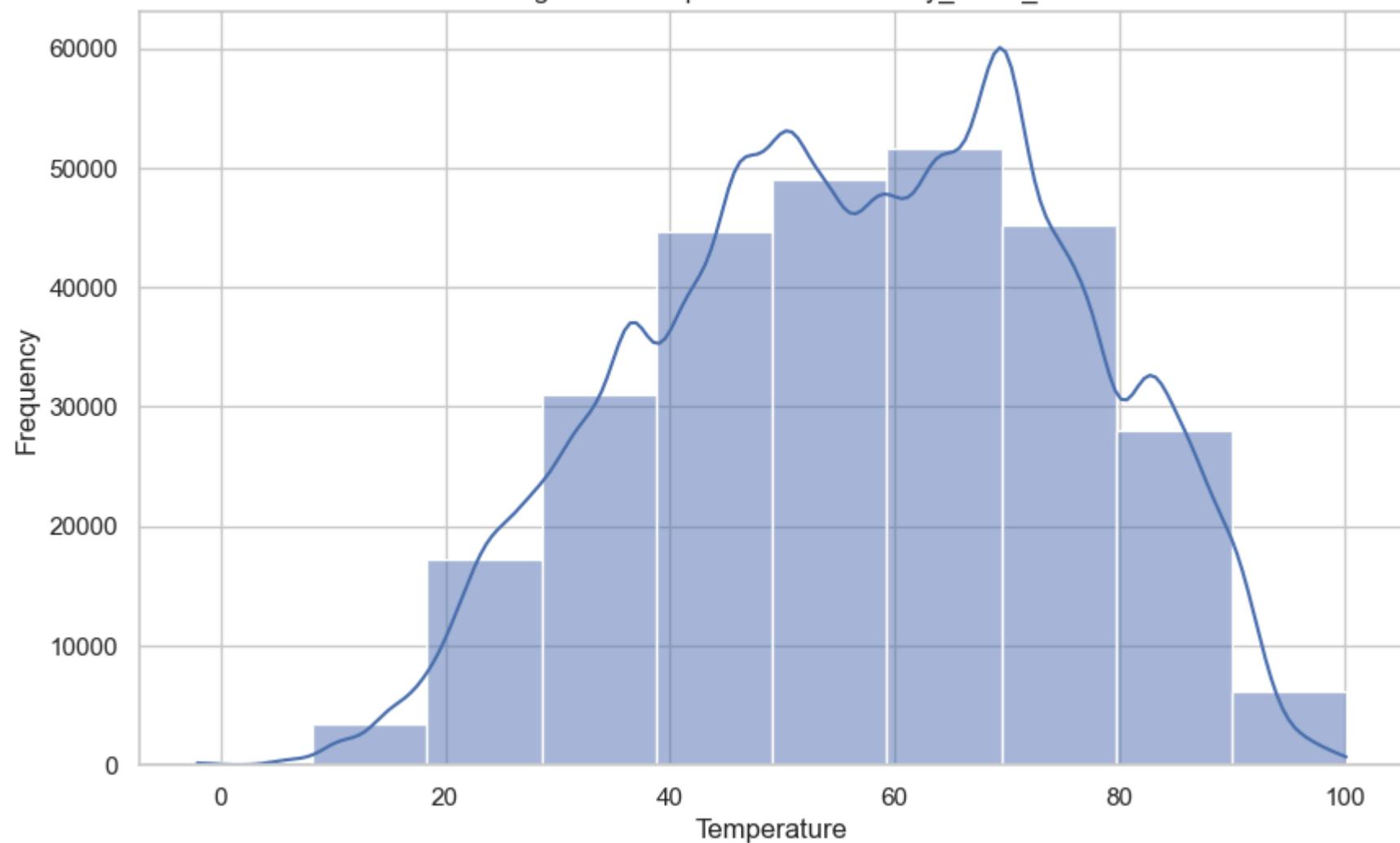


Box Plot of IsHoliday in Data with Weekly_Sales_8w

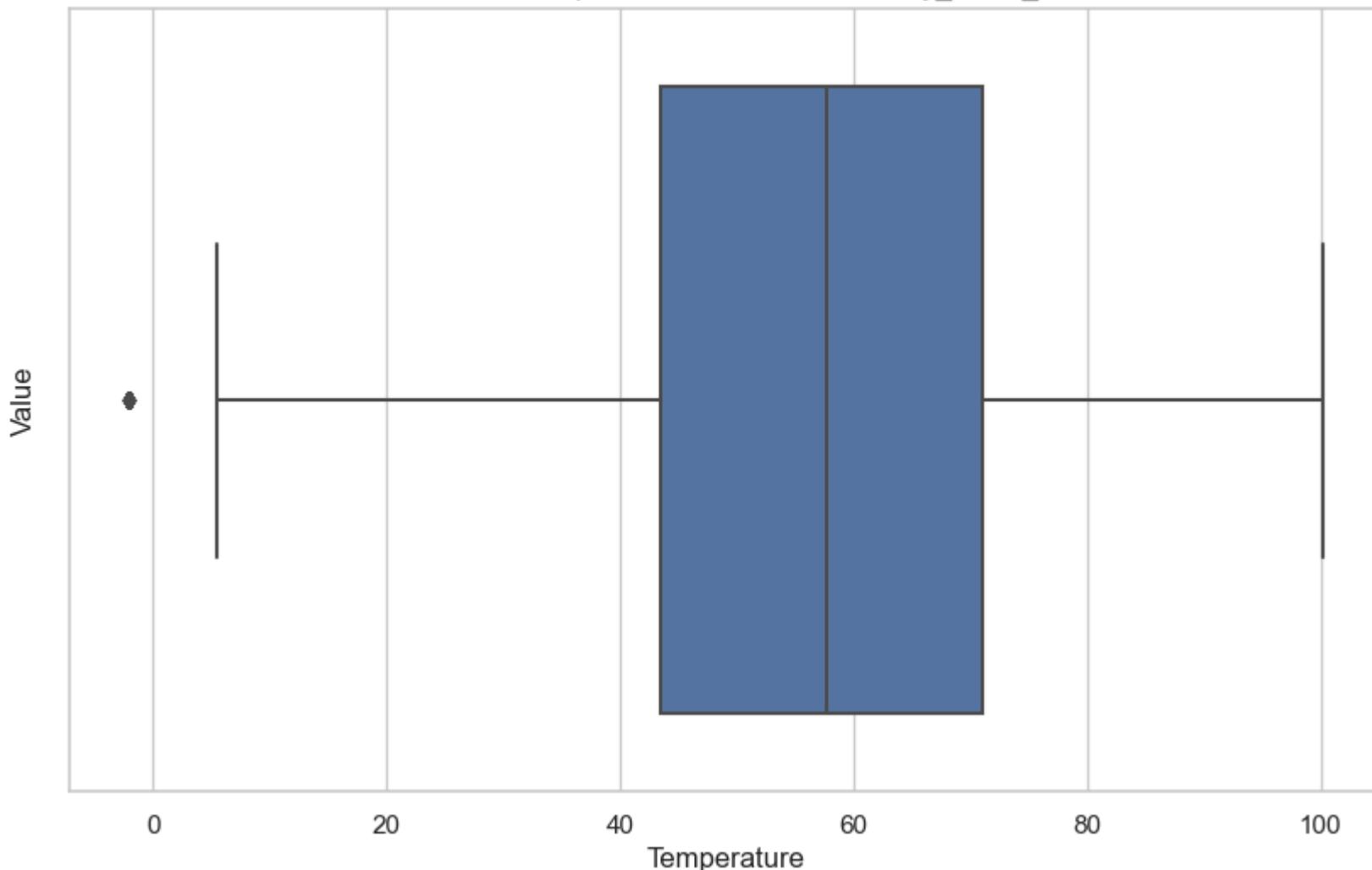


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_8w

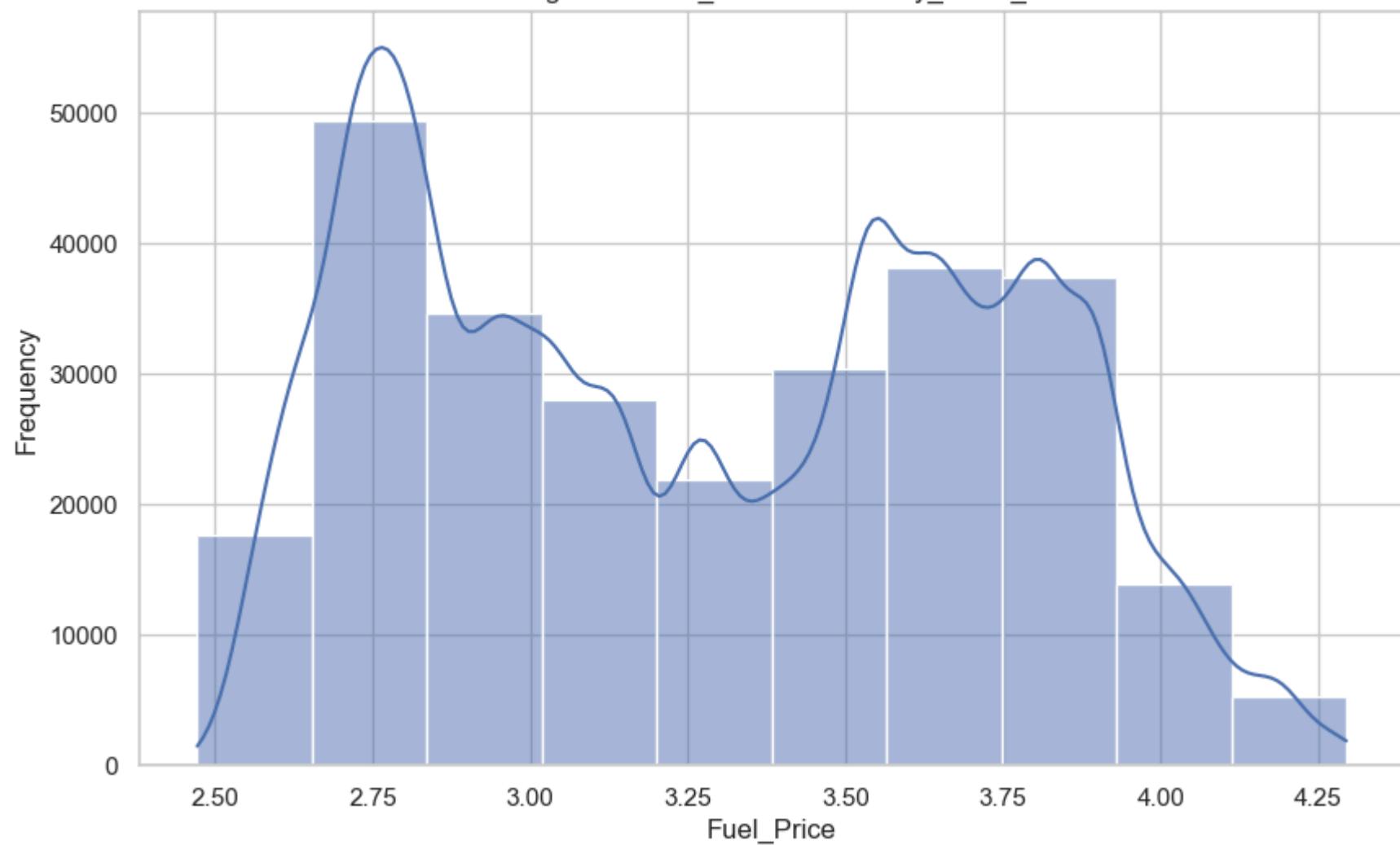


Box Plot of Temperature in Data with Weekly_Sales_8w

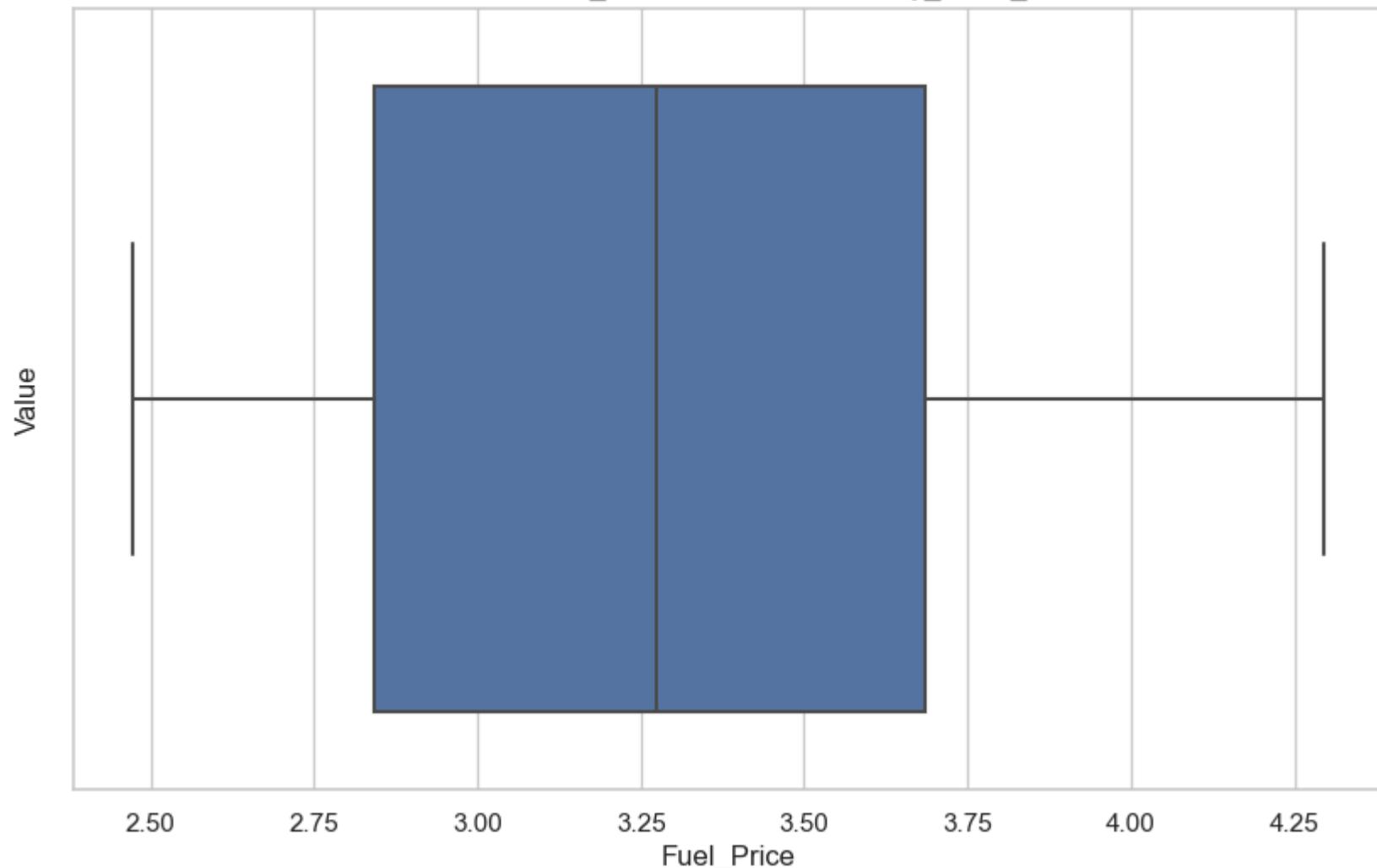


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

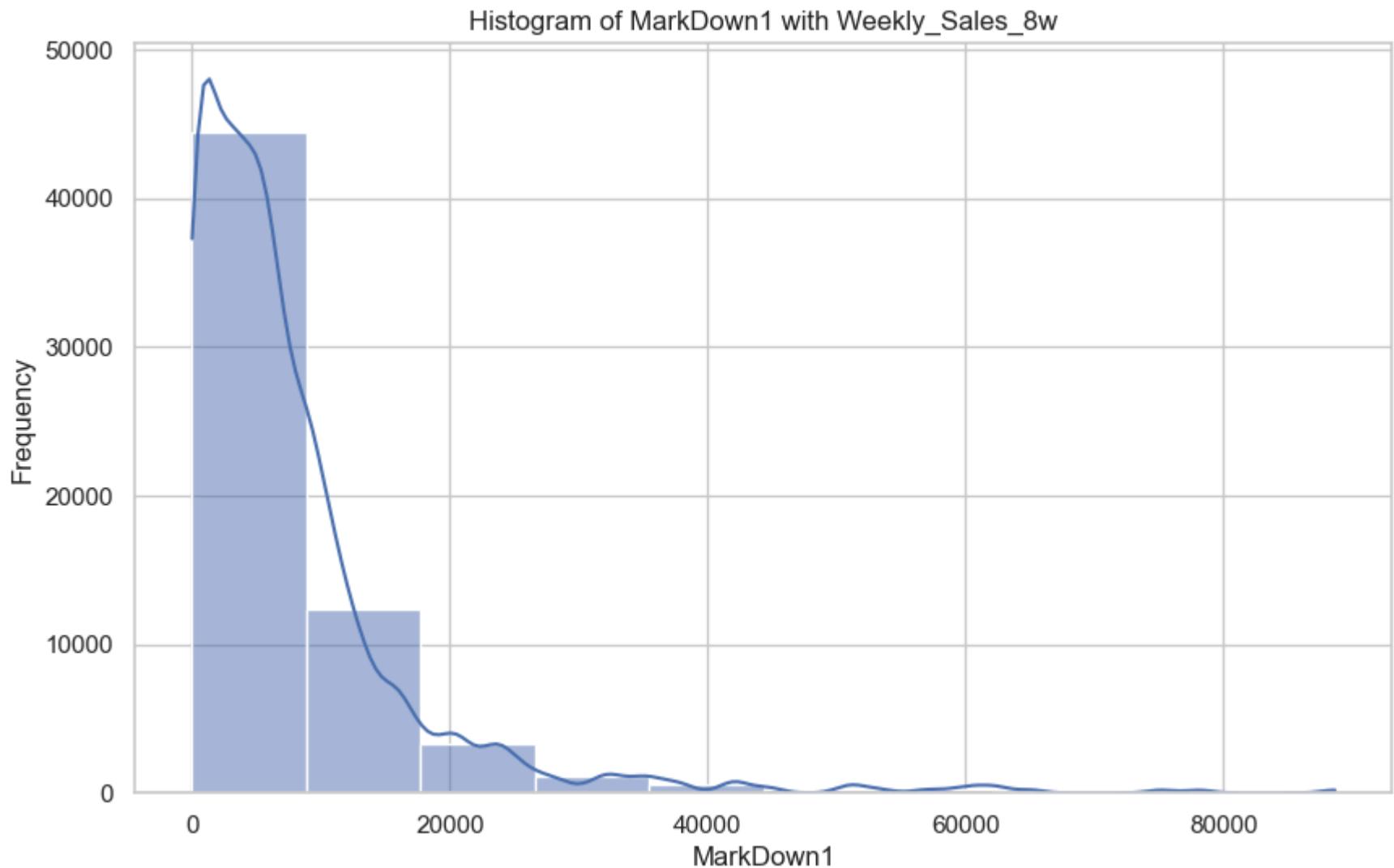
Histogram of Fuel_Price with Weekly_Sales_8w



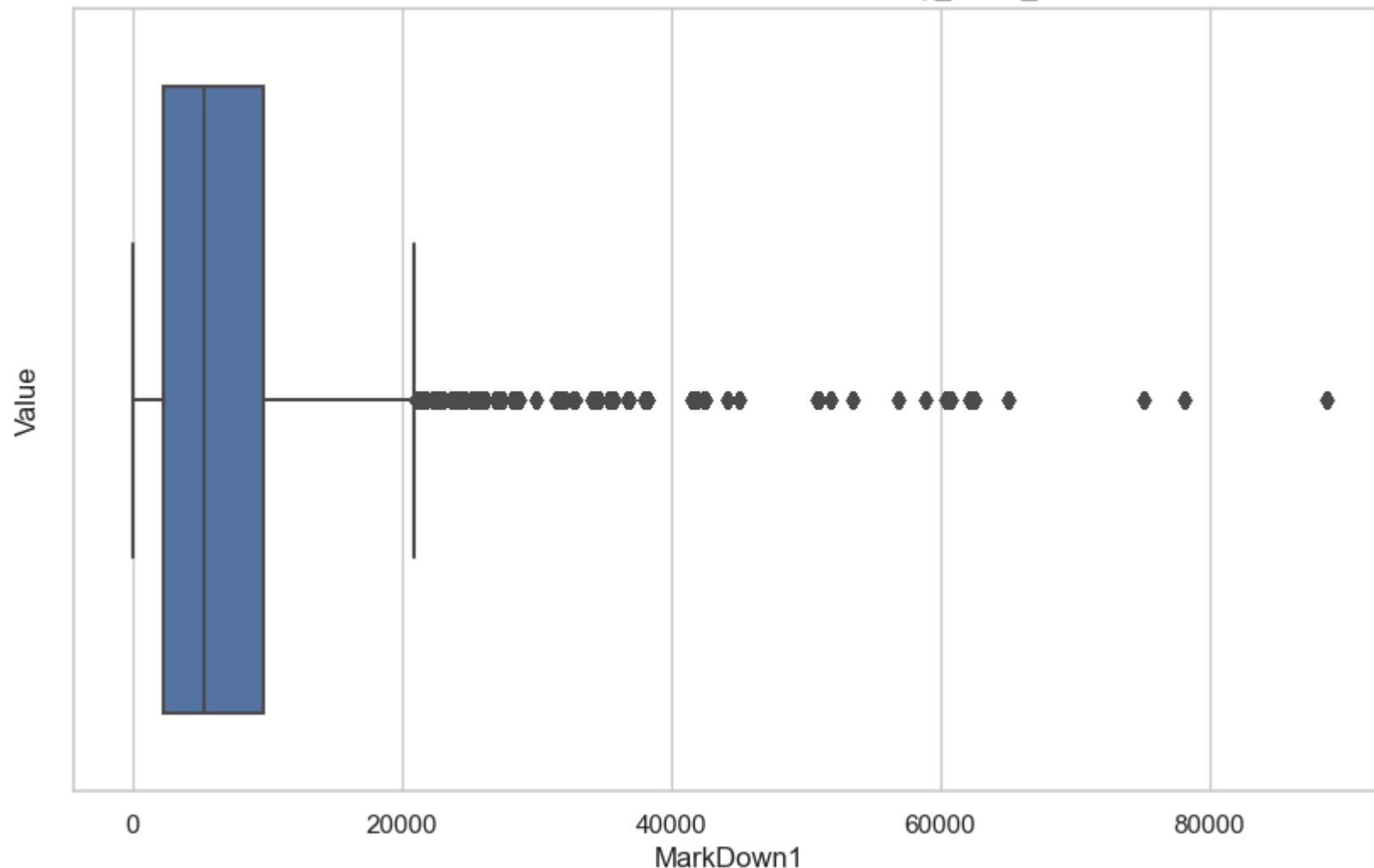
Box Plot of Fuel_Price in Data with Weekly_Sales_8w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

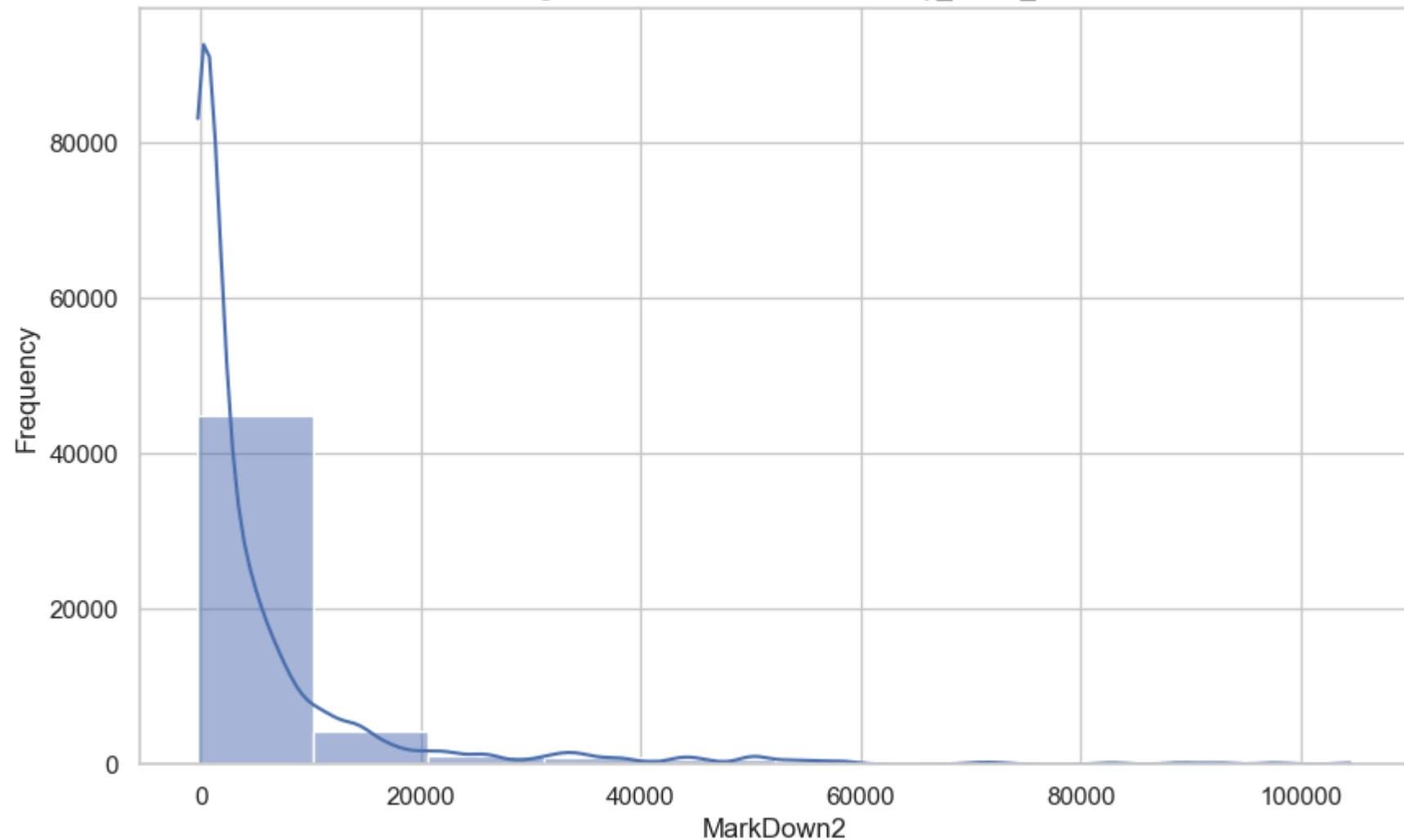


Box Plot of MarkDown1 in Data with Weekly_Sales_8w

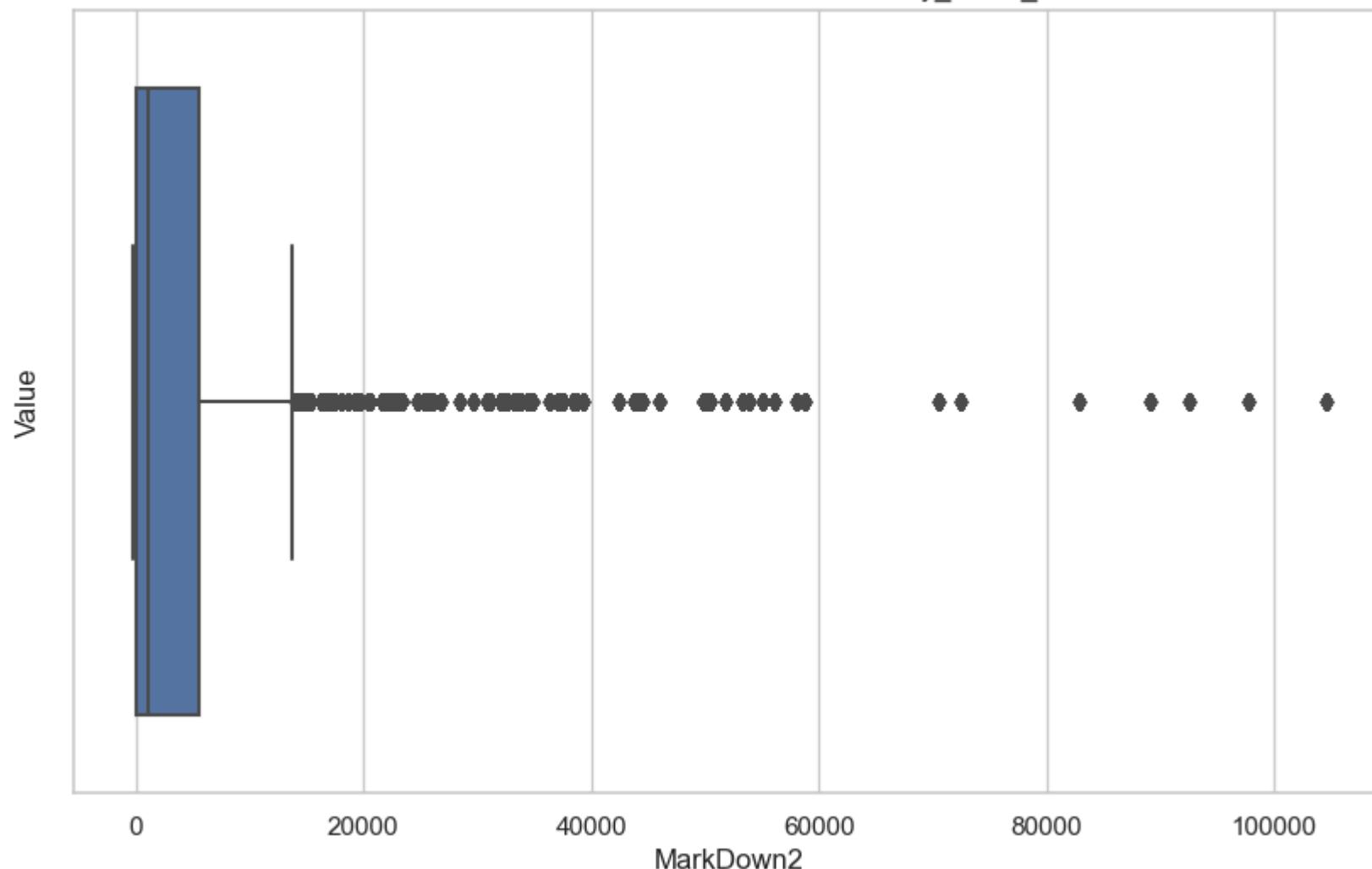


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_8w

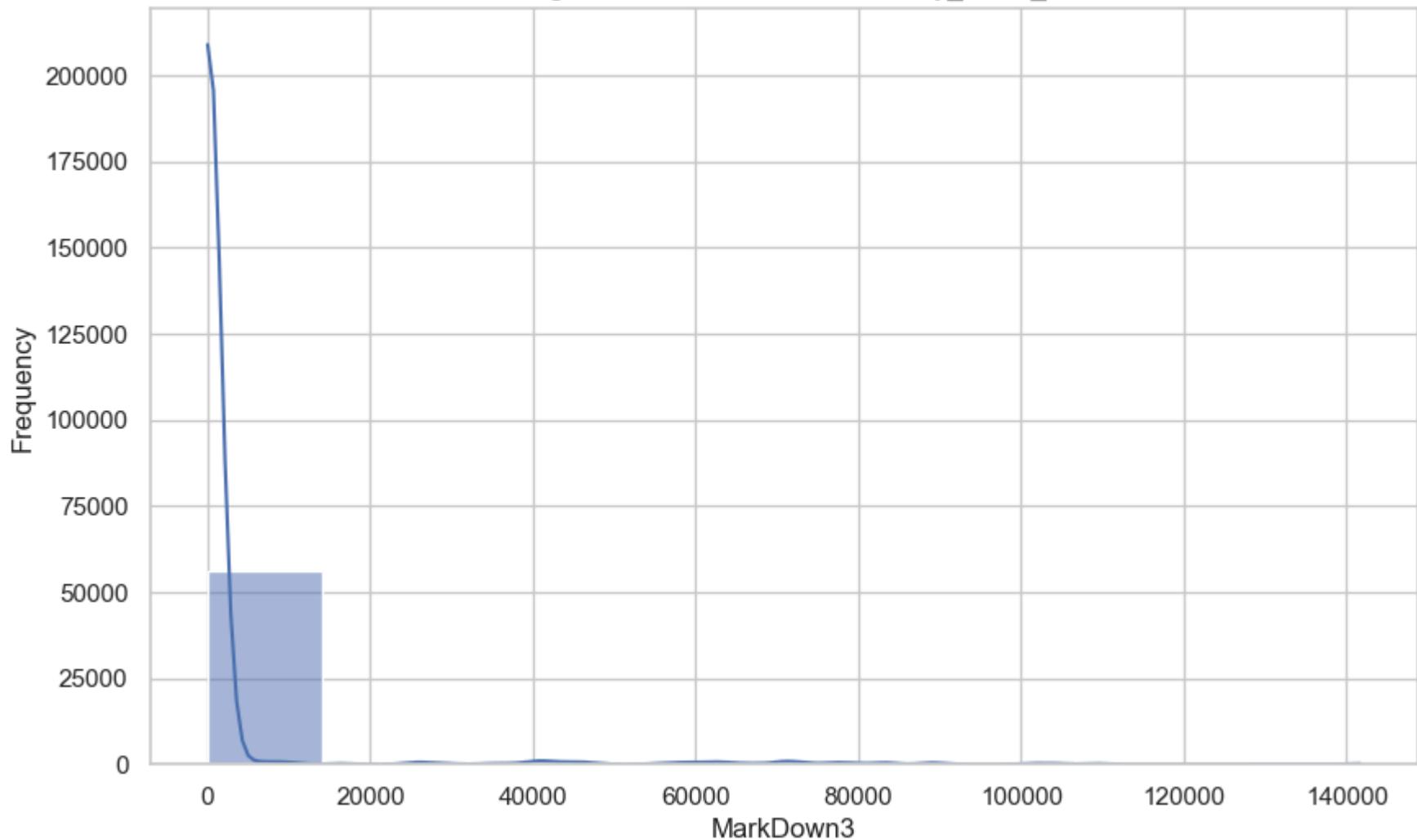


Box Plot of MarkDown2 in Data with Weekly_Sales_8w

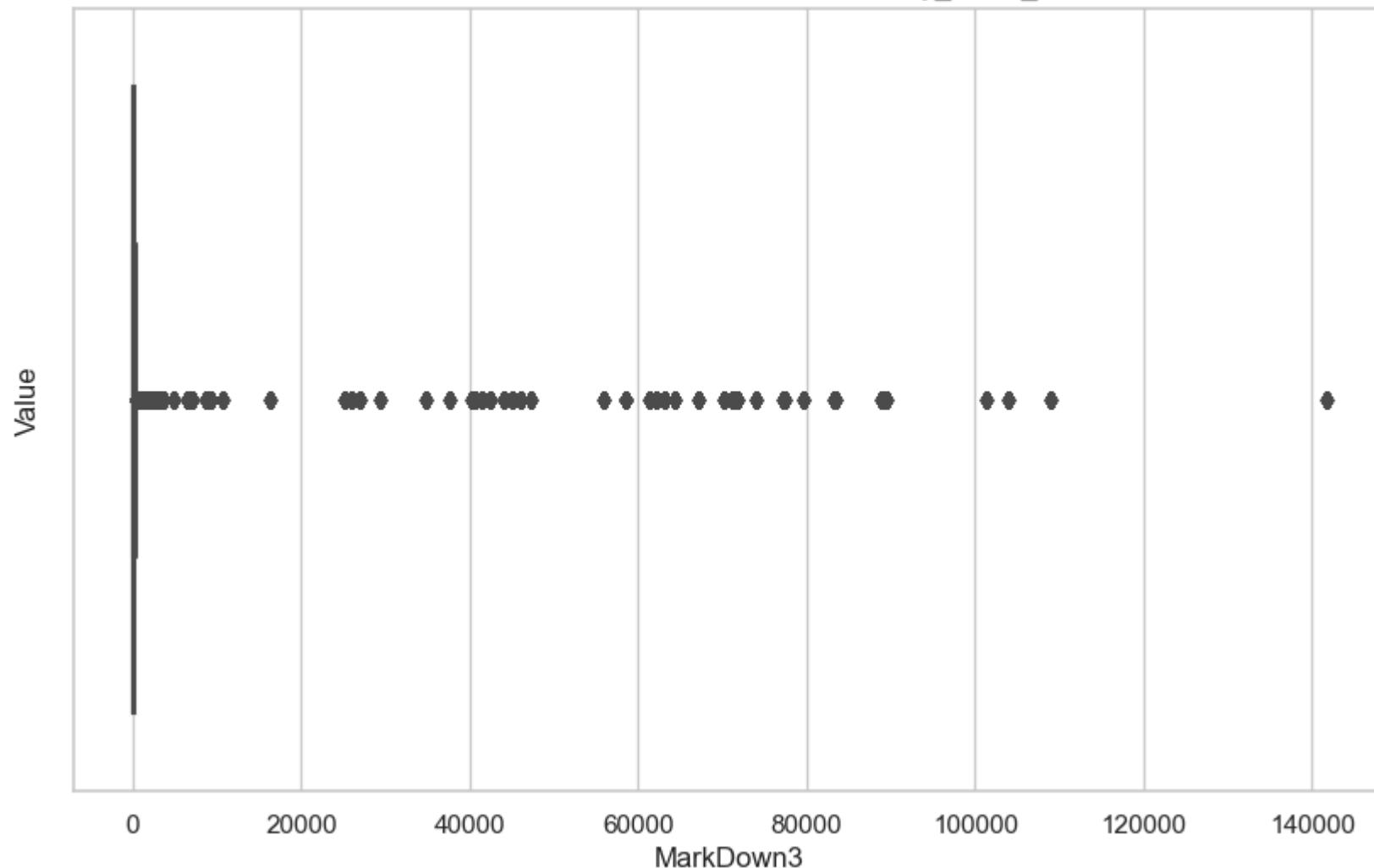


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_8w

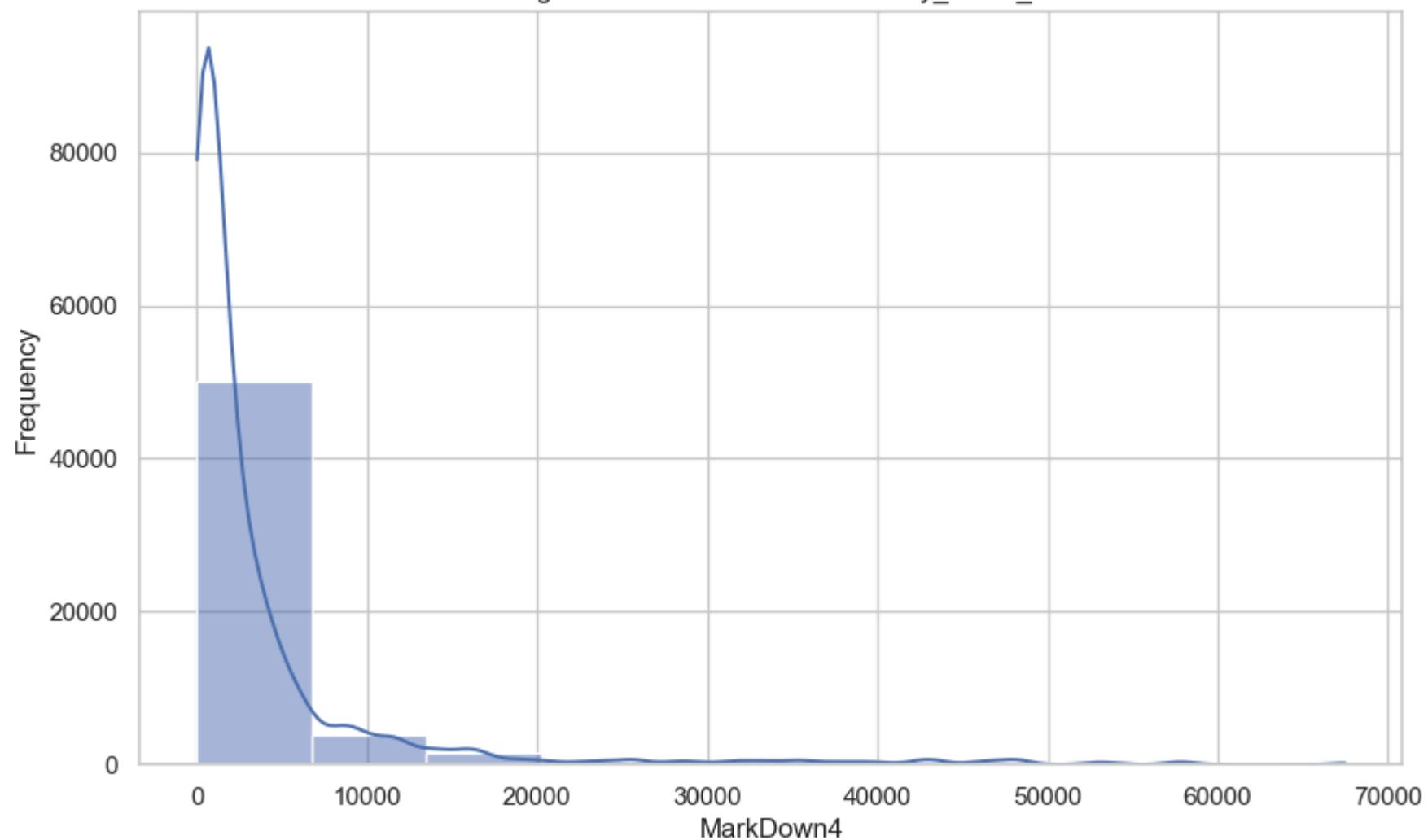


Box Plot of MarkDown3 in Data with Weekly_Sales_8w

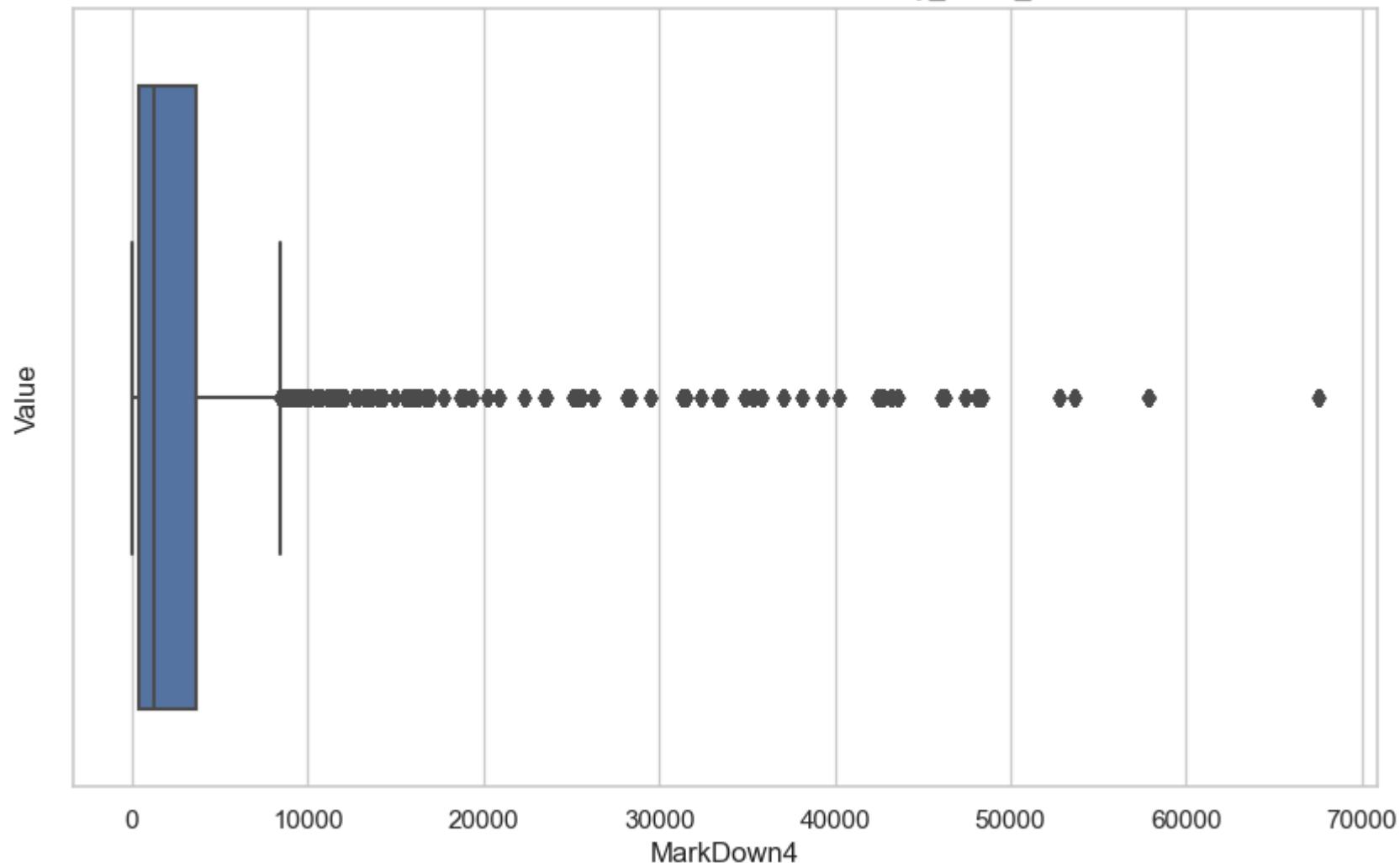


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_8w

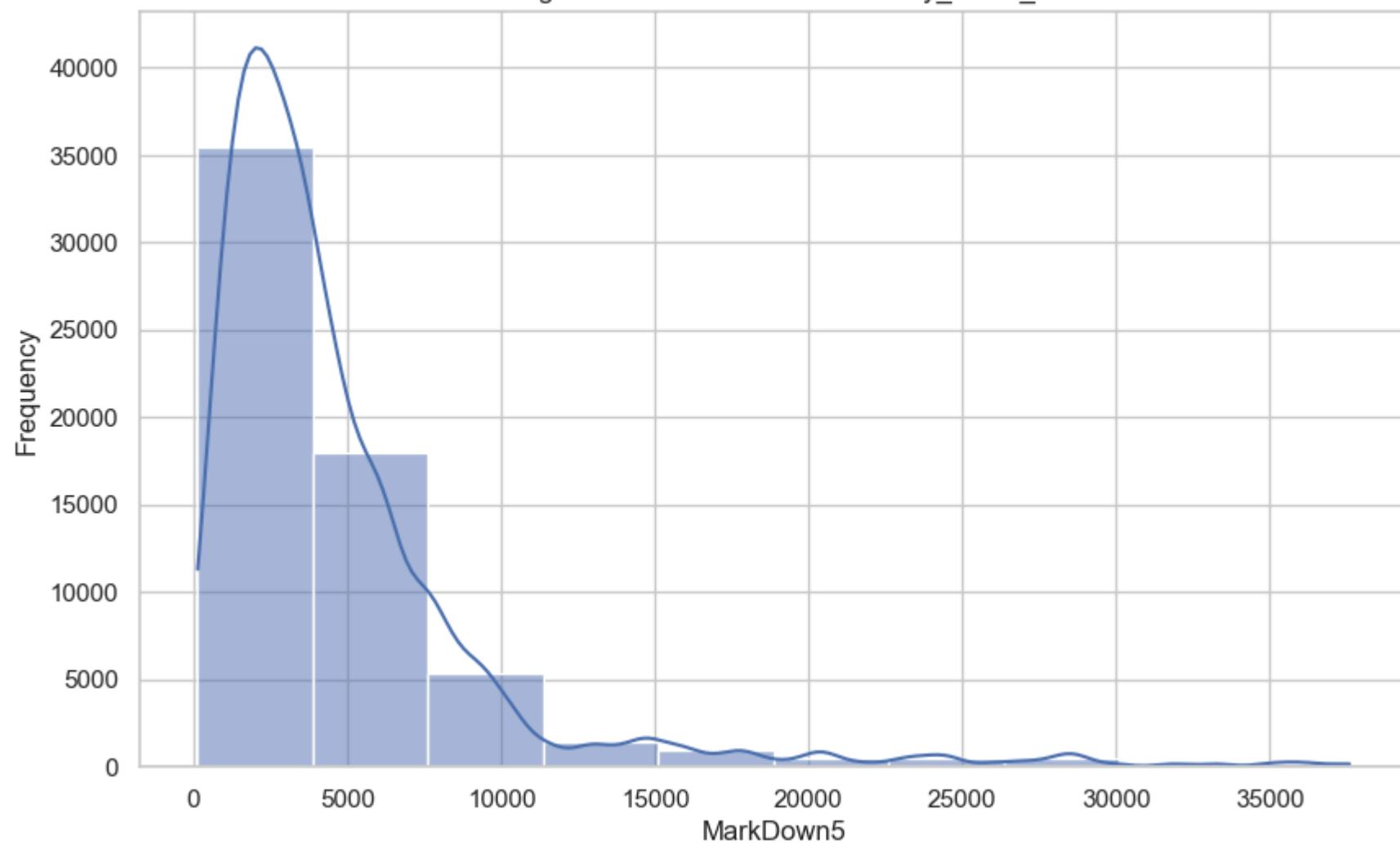


Box Plot of MarkDown4 in Data with Weekly_Sales_8w

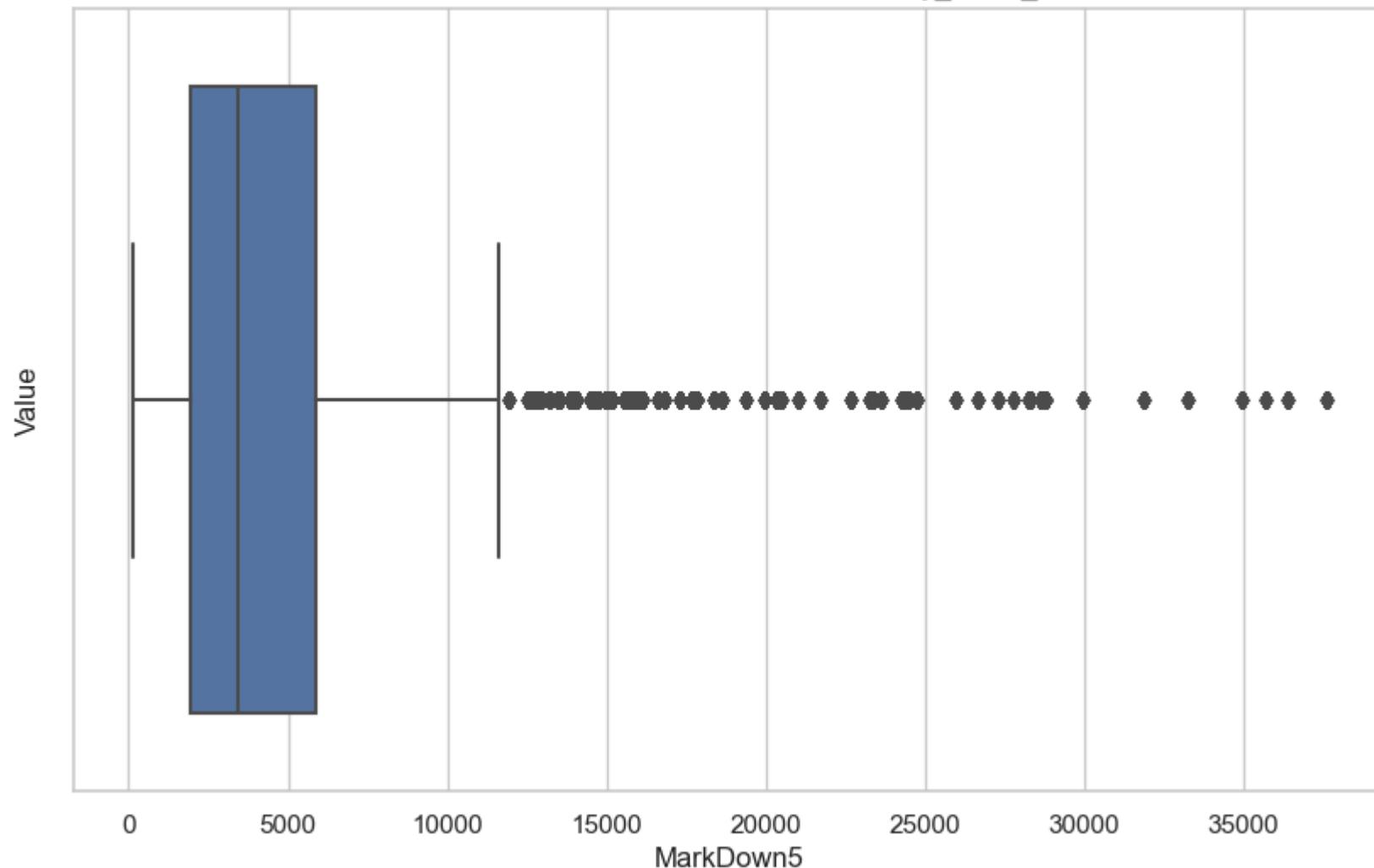


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_8w

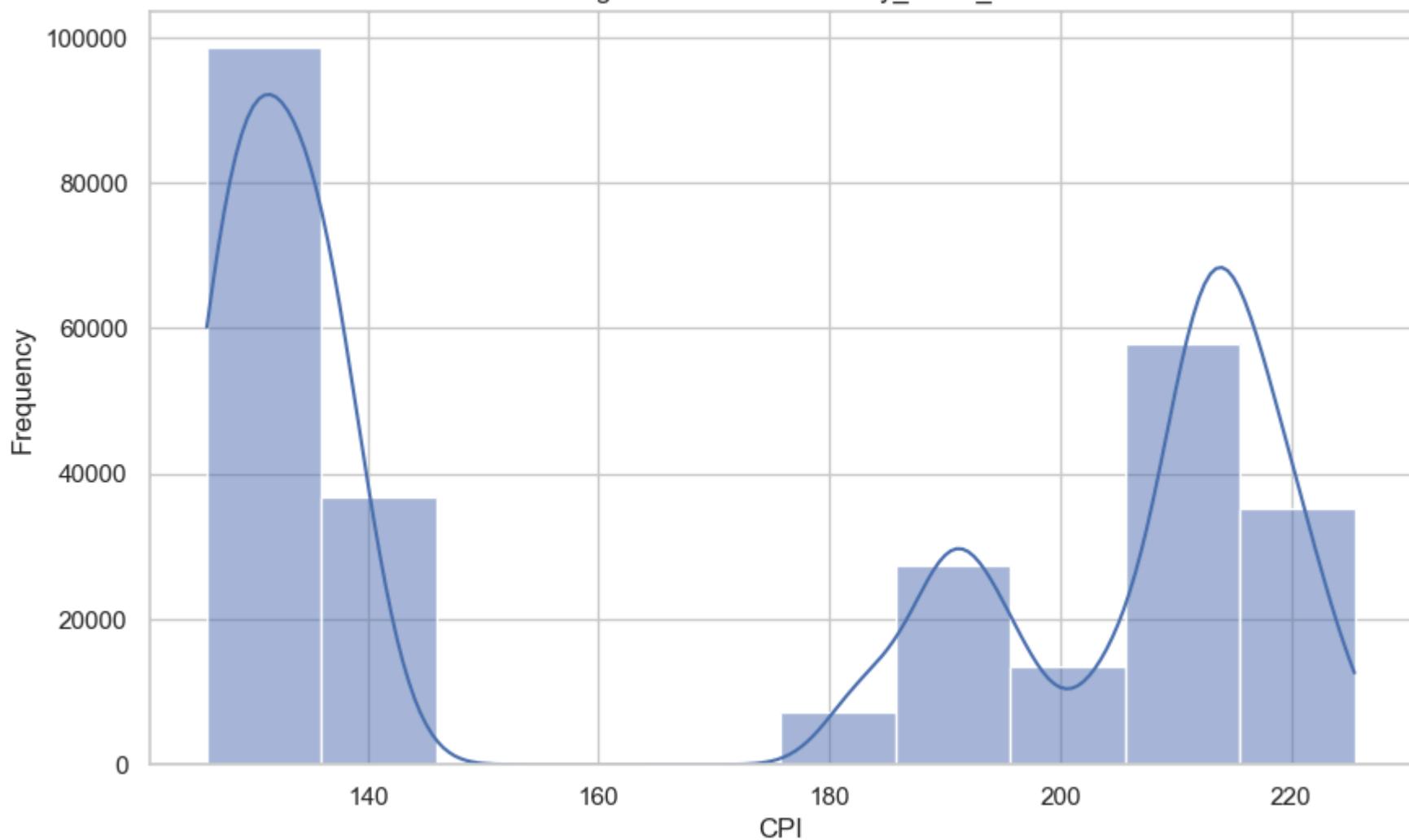


Box Plot of MarkDown5 in Data with Weekly_Sales_8w

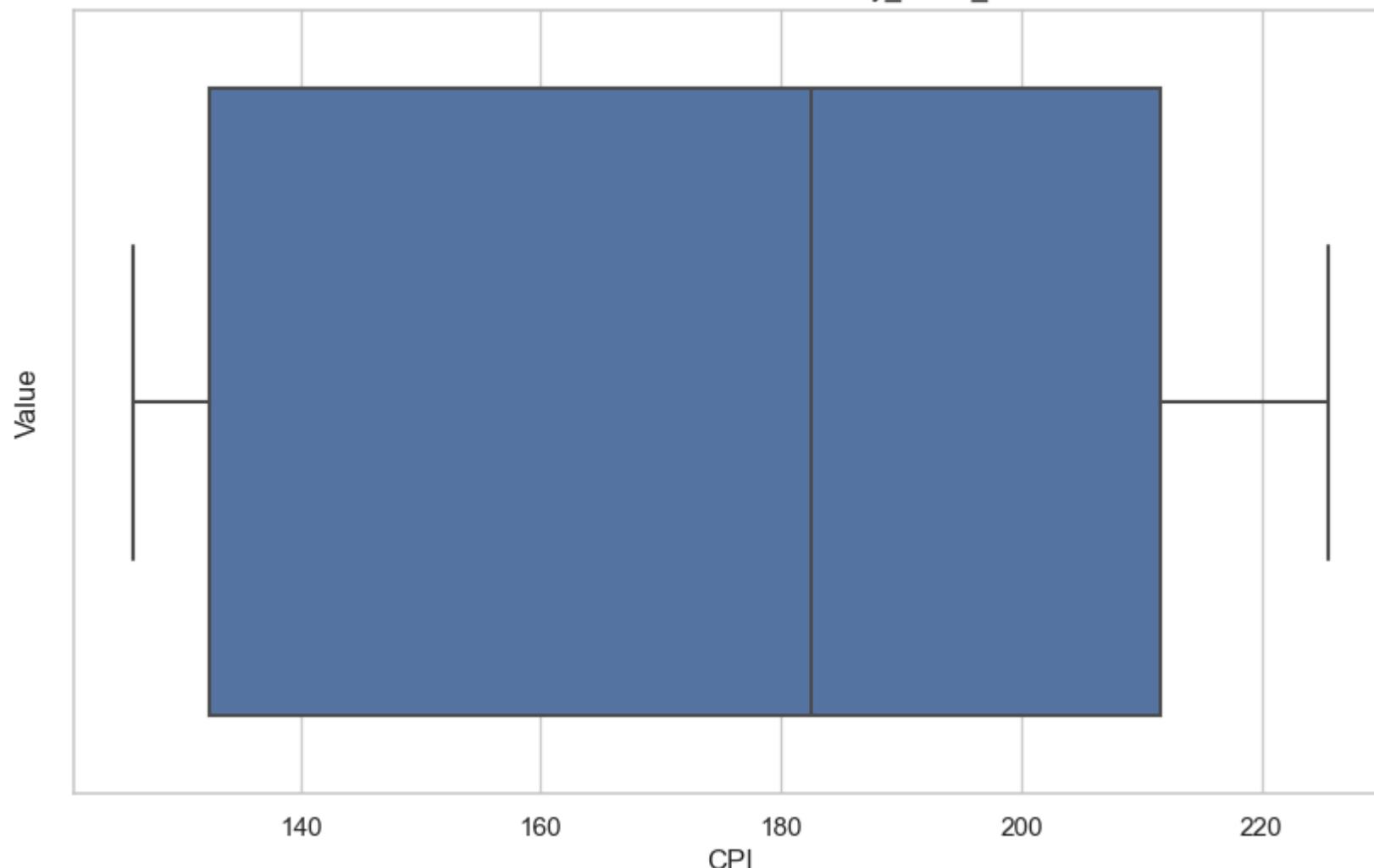


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_8w

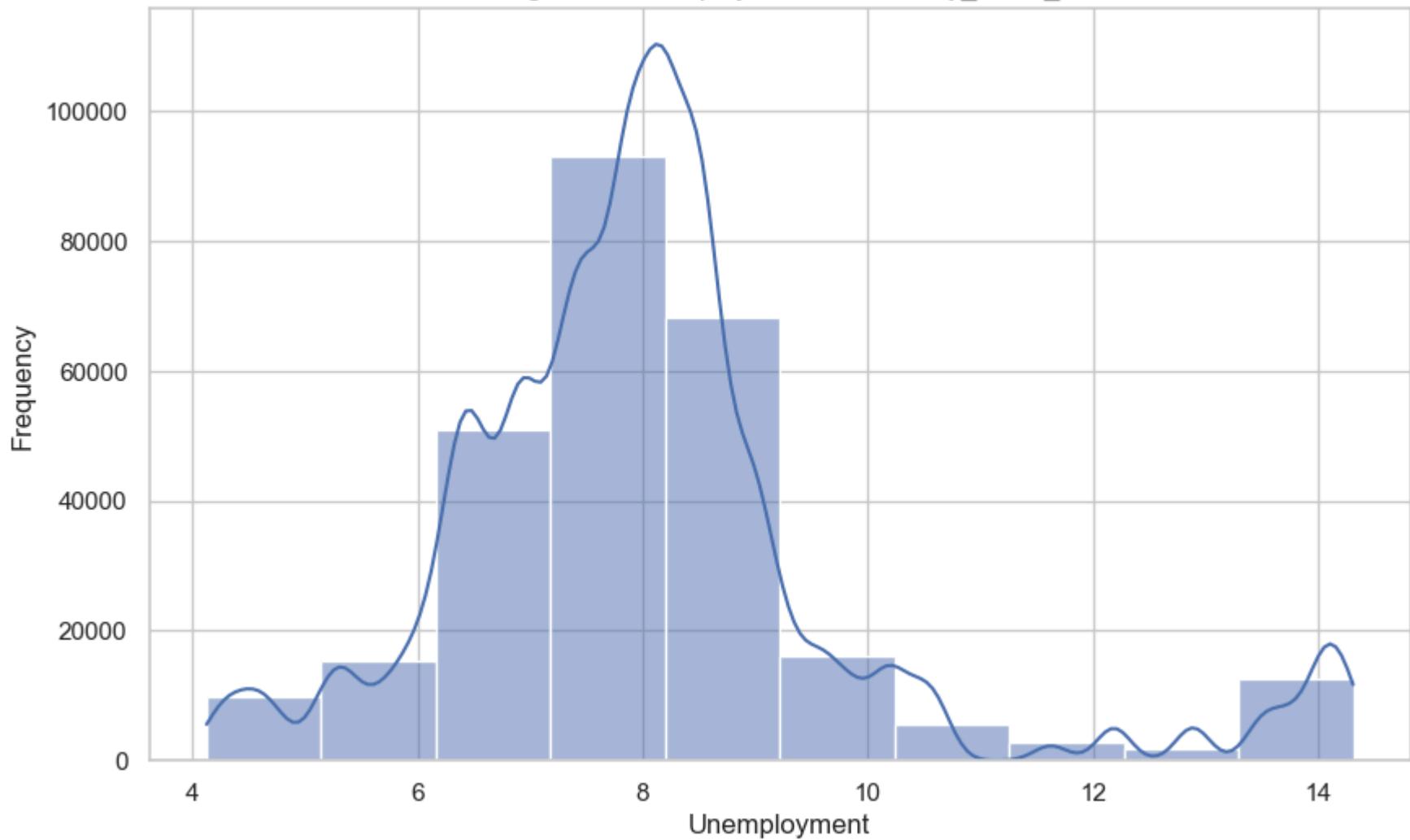


Box Plot of CPI in Data with Weekly_Sales_8w

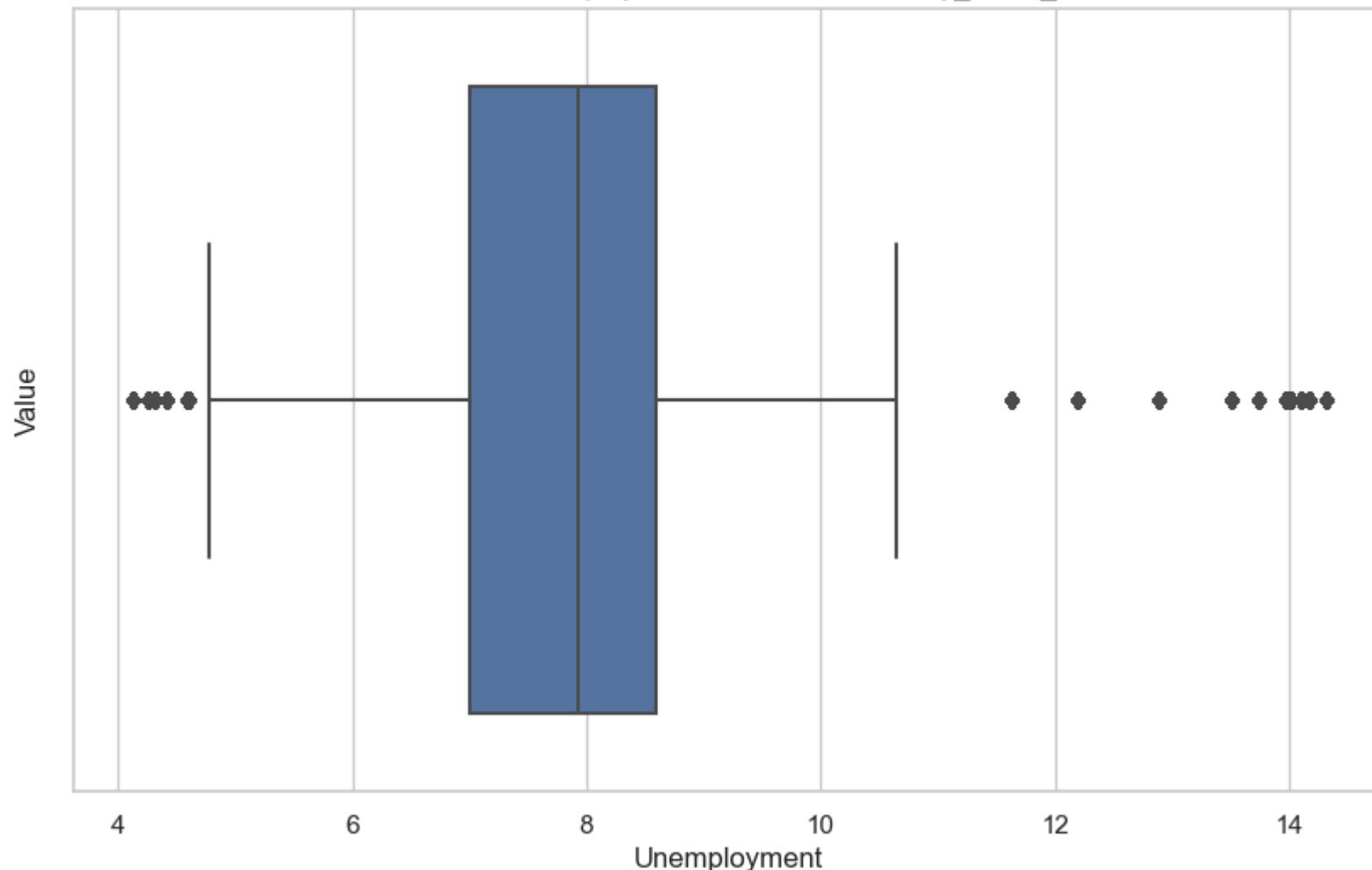


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_8w

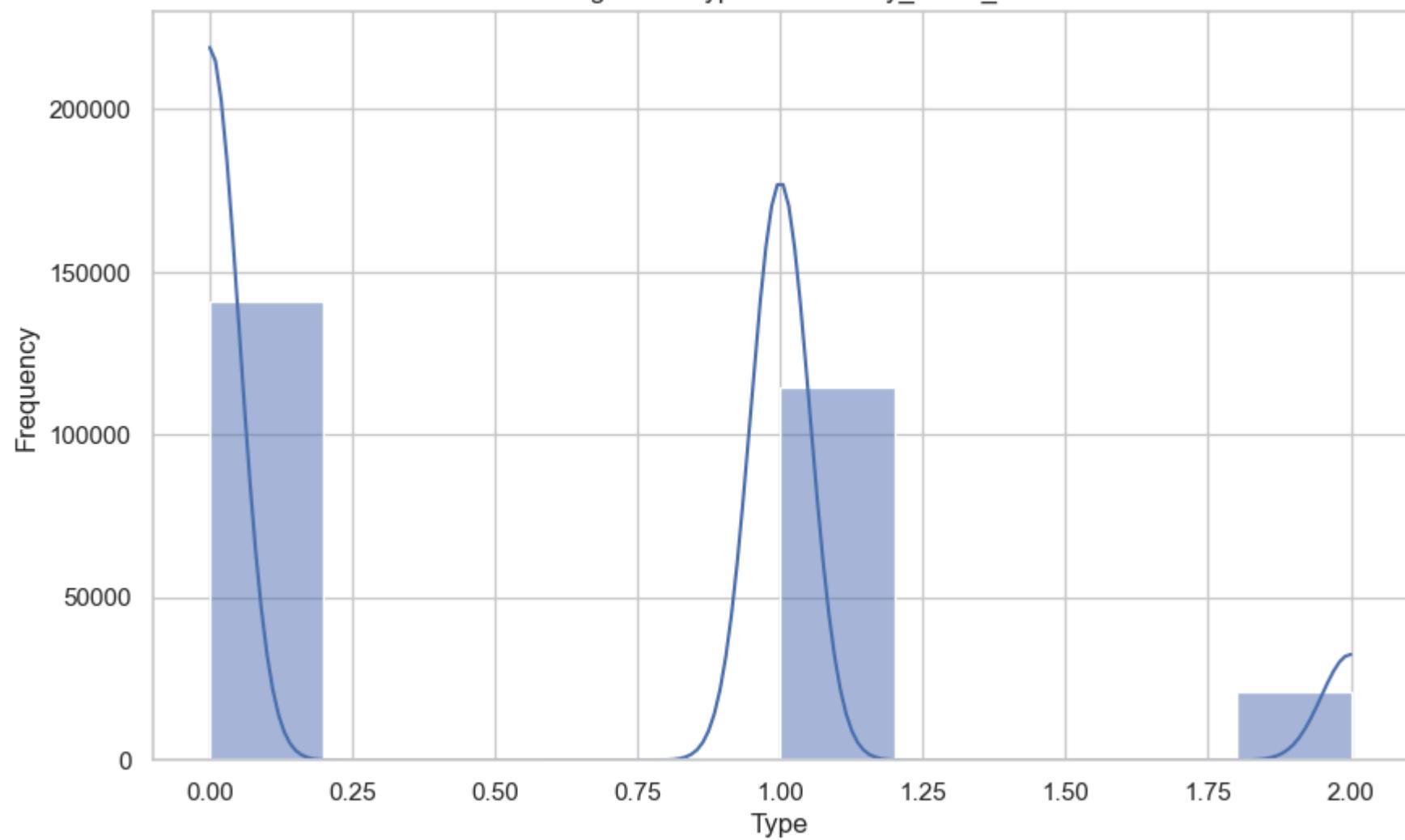


Box Plot of Unemployment in Data with Weekly_Sales_8w

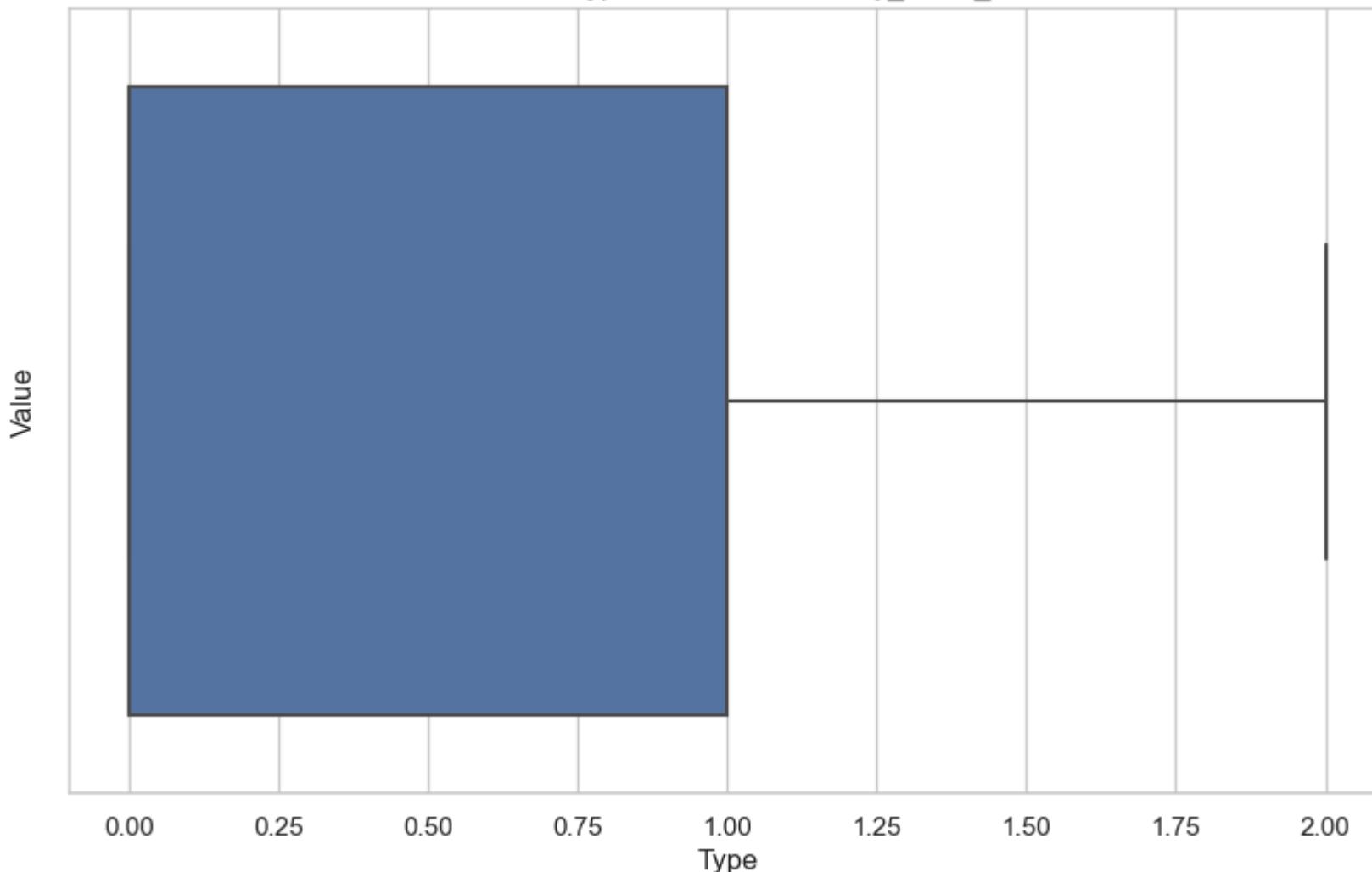


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_8w

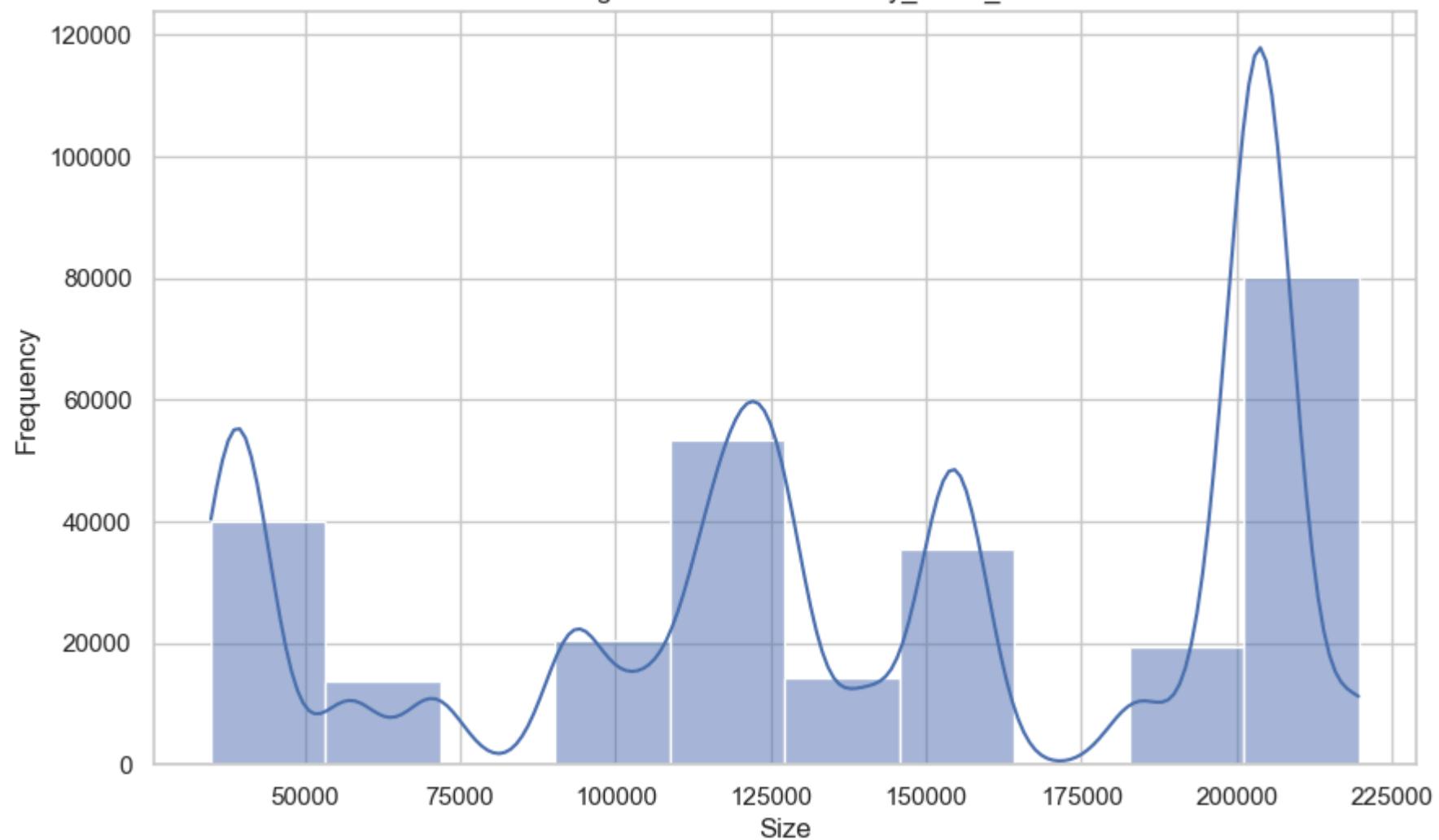


Box Plot of Type in Data with Weekly_Sales_8w

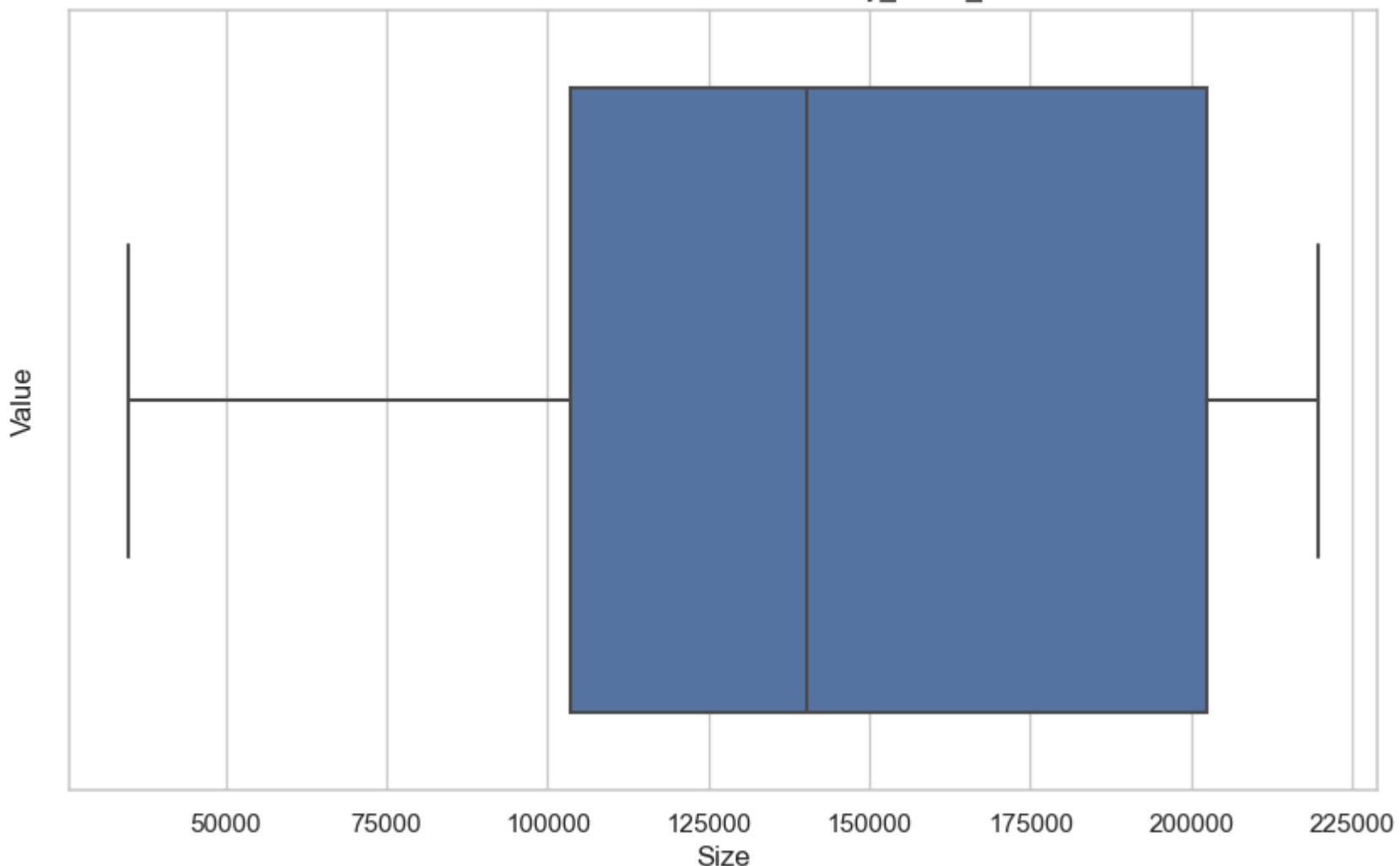


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_8w

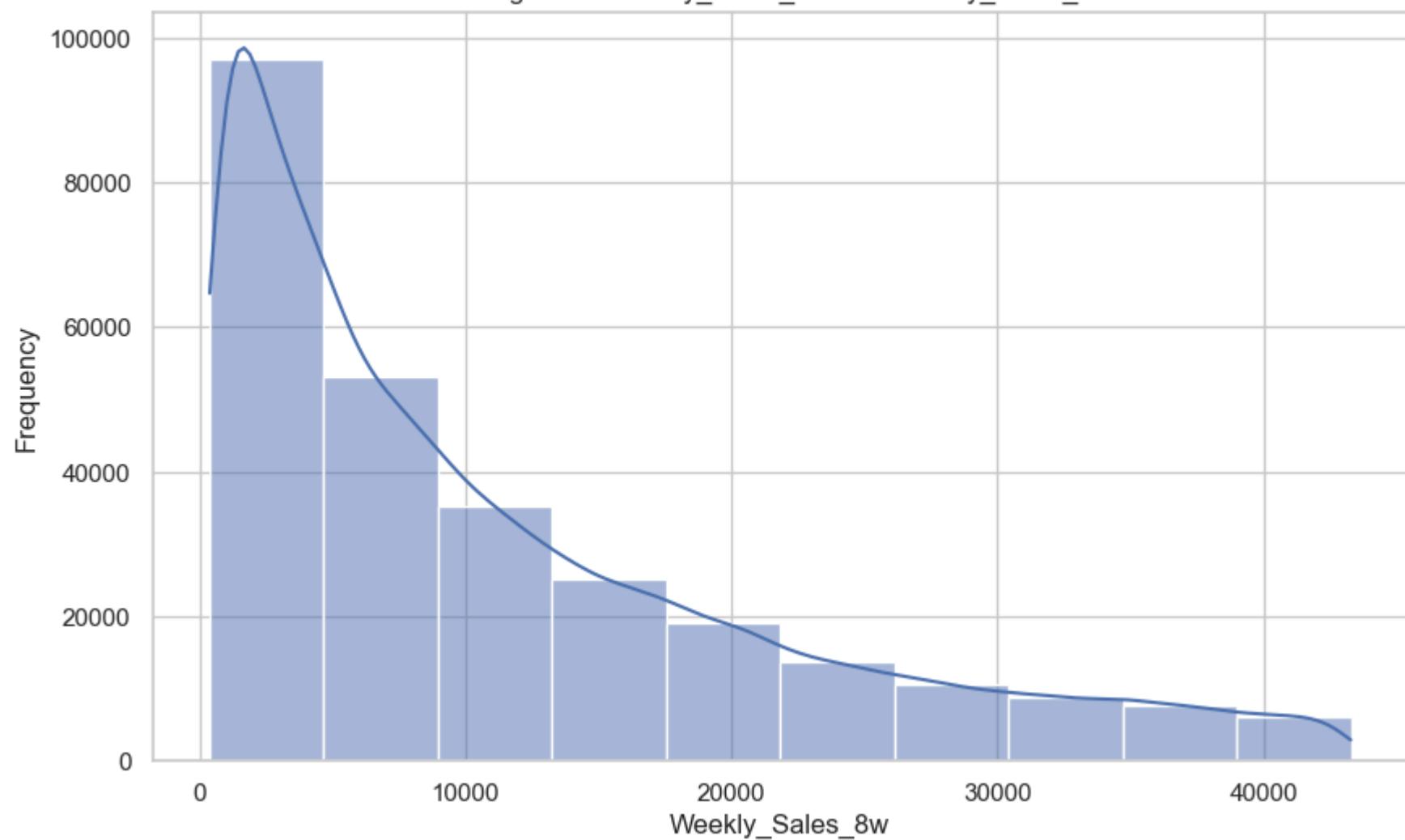


Box Plot of Size in Data with Weekly_Sales_8w

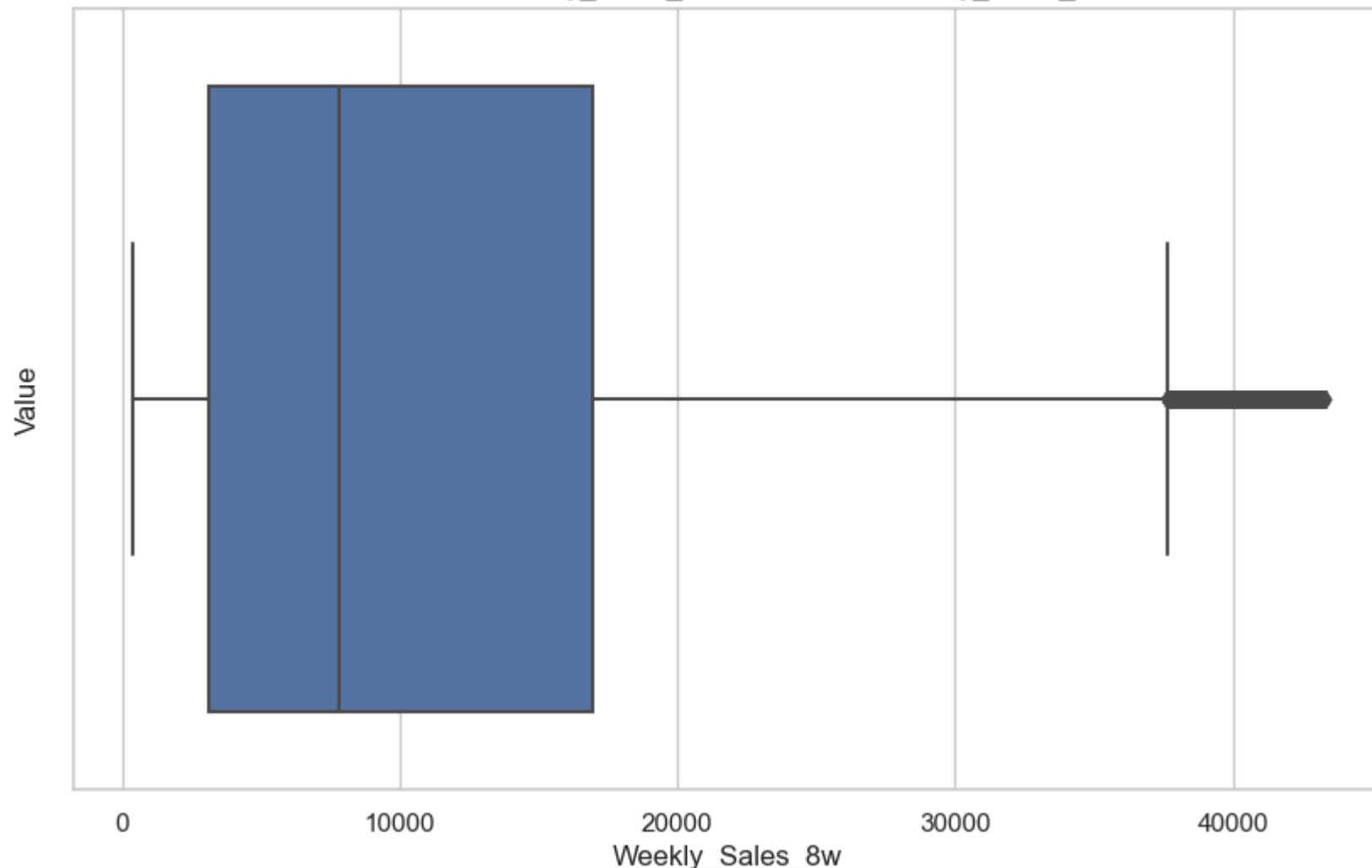


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_8w with Weekly_Sales_8w

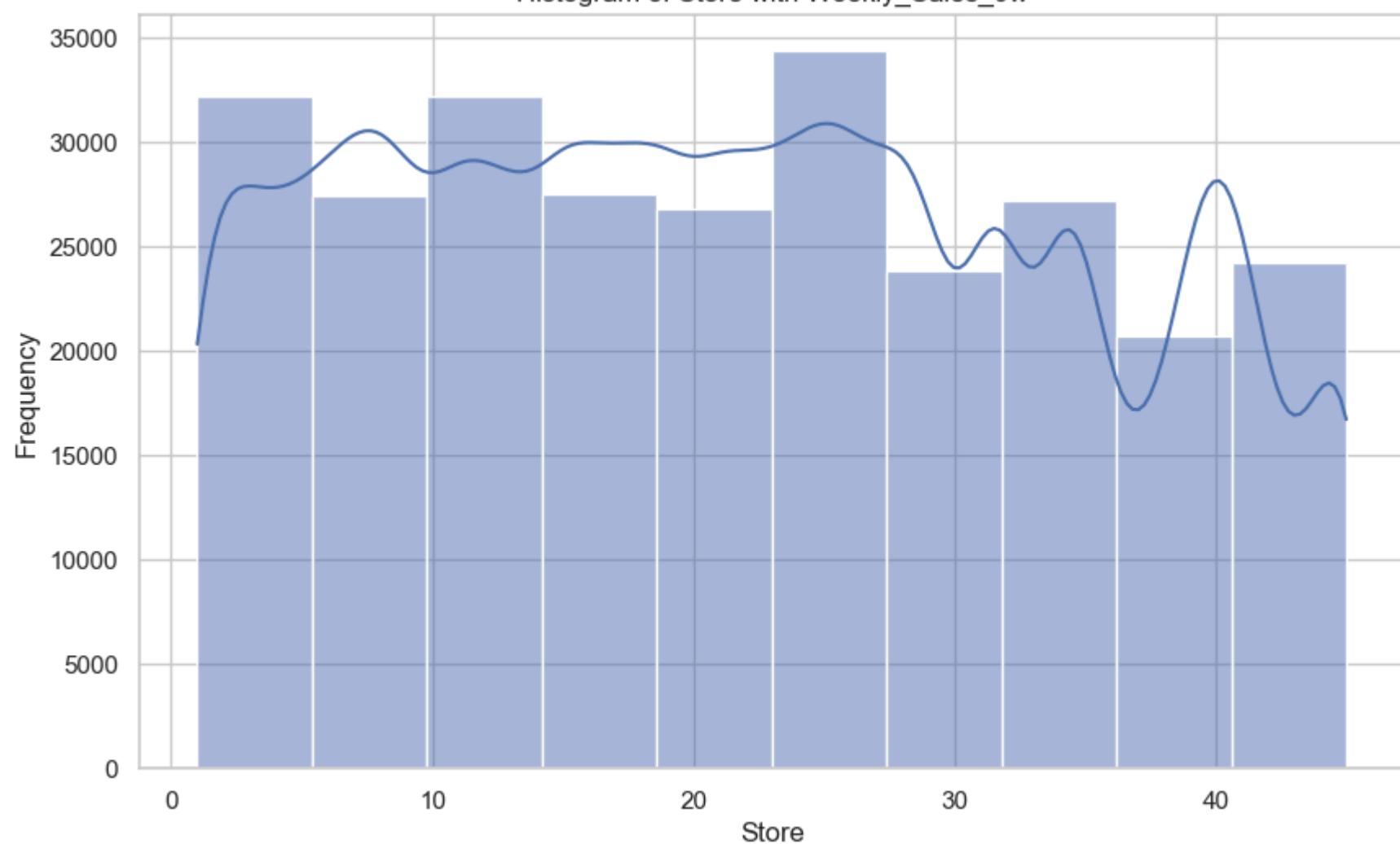


Box Plot of Weekly_Sales_8w in Data with Weekly_Sales_8w

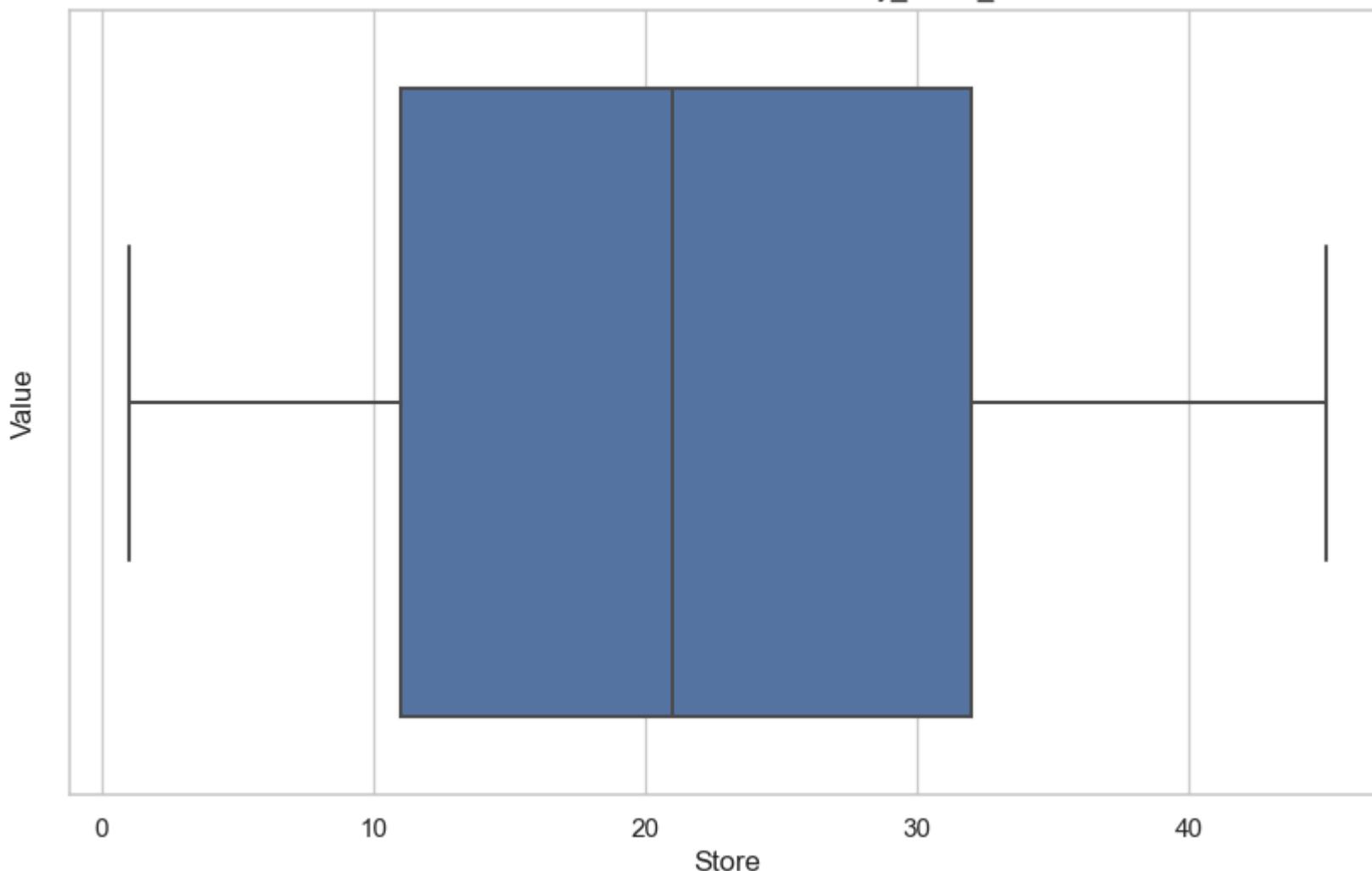


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_9w

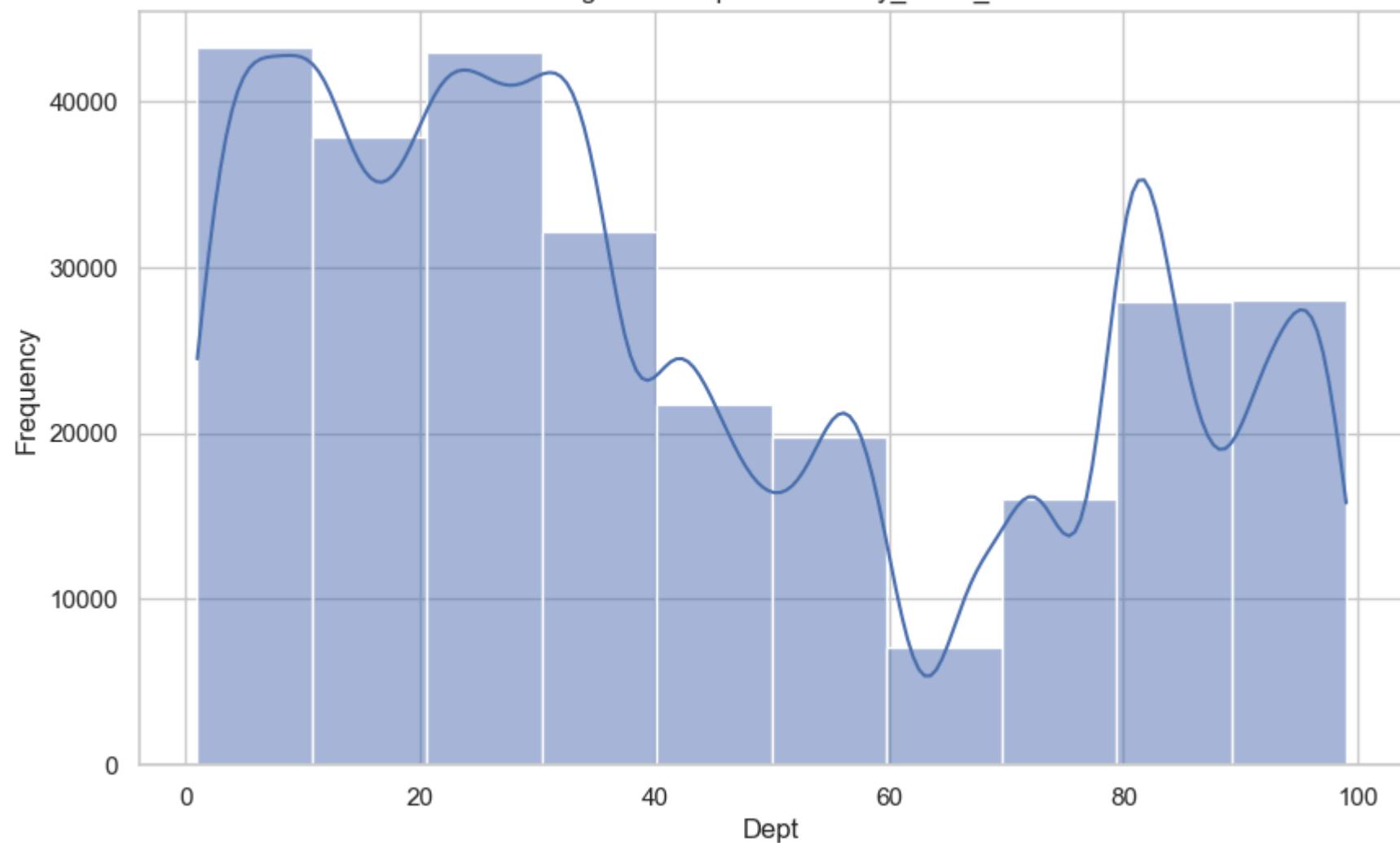


Box Plot of Store in Data with Weekly_Sales_9w

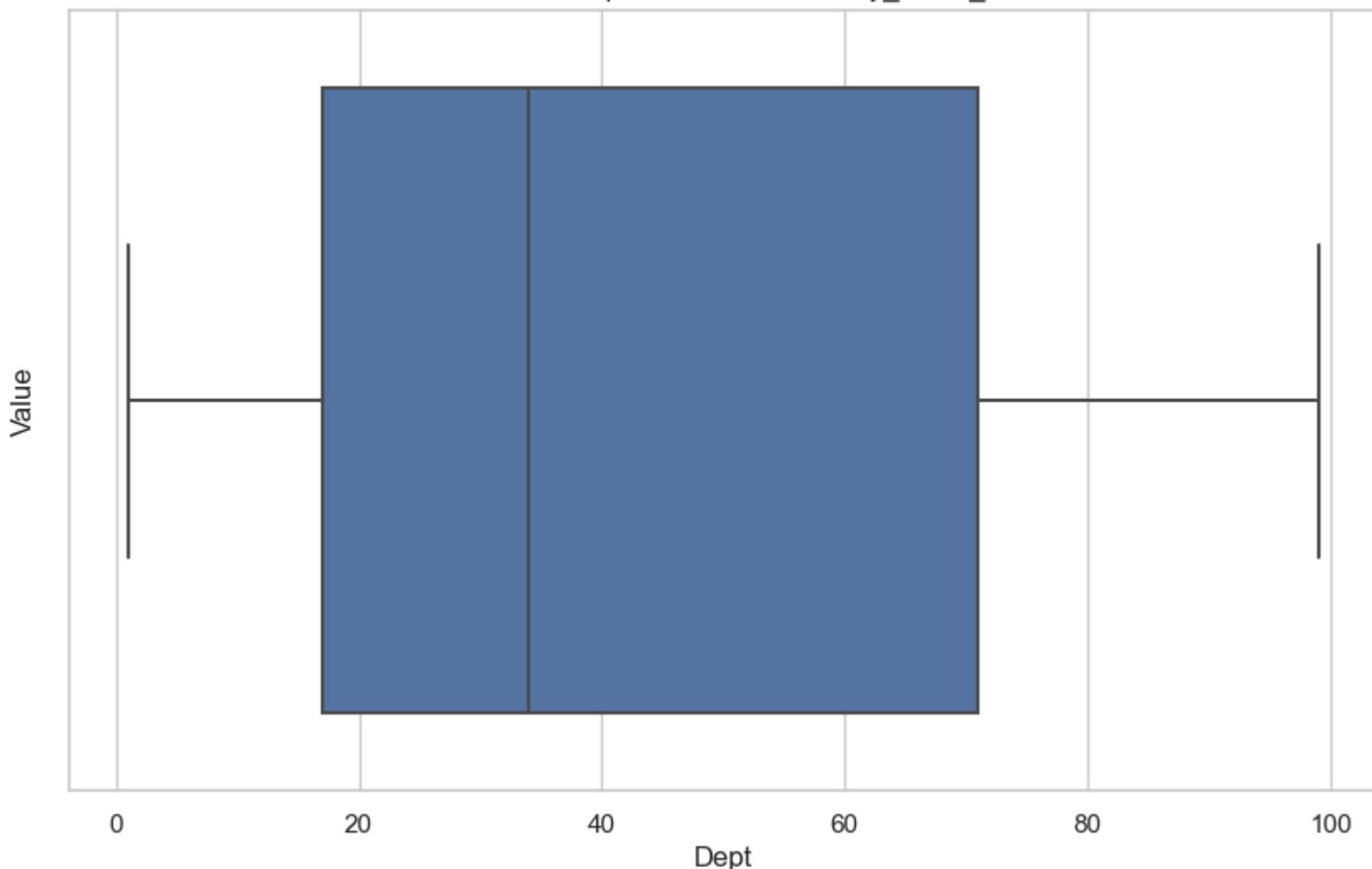


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_9w

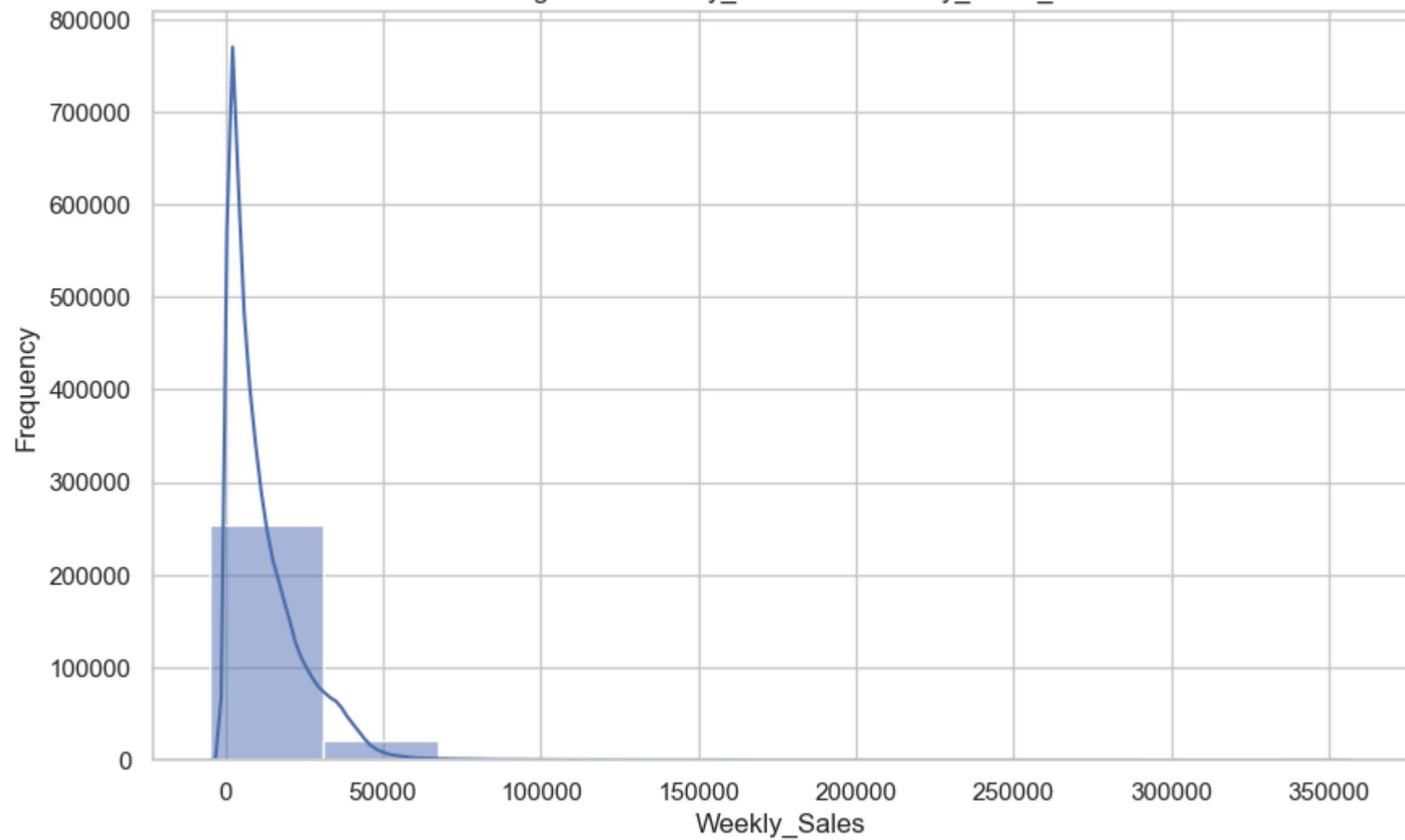


Box Plot of Dept in Data with Weekly_Sales_9w

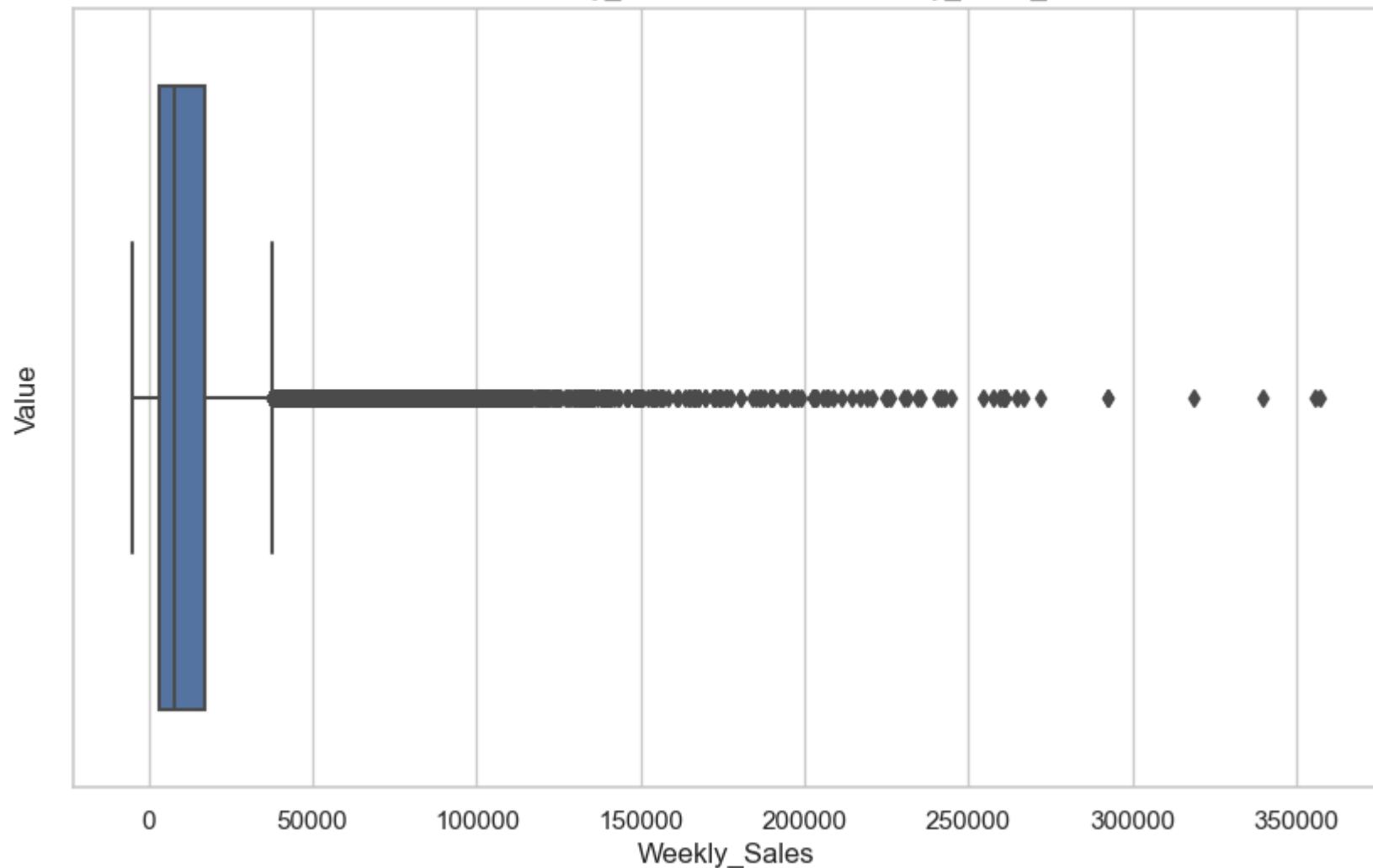


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_9w

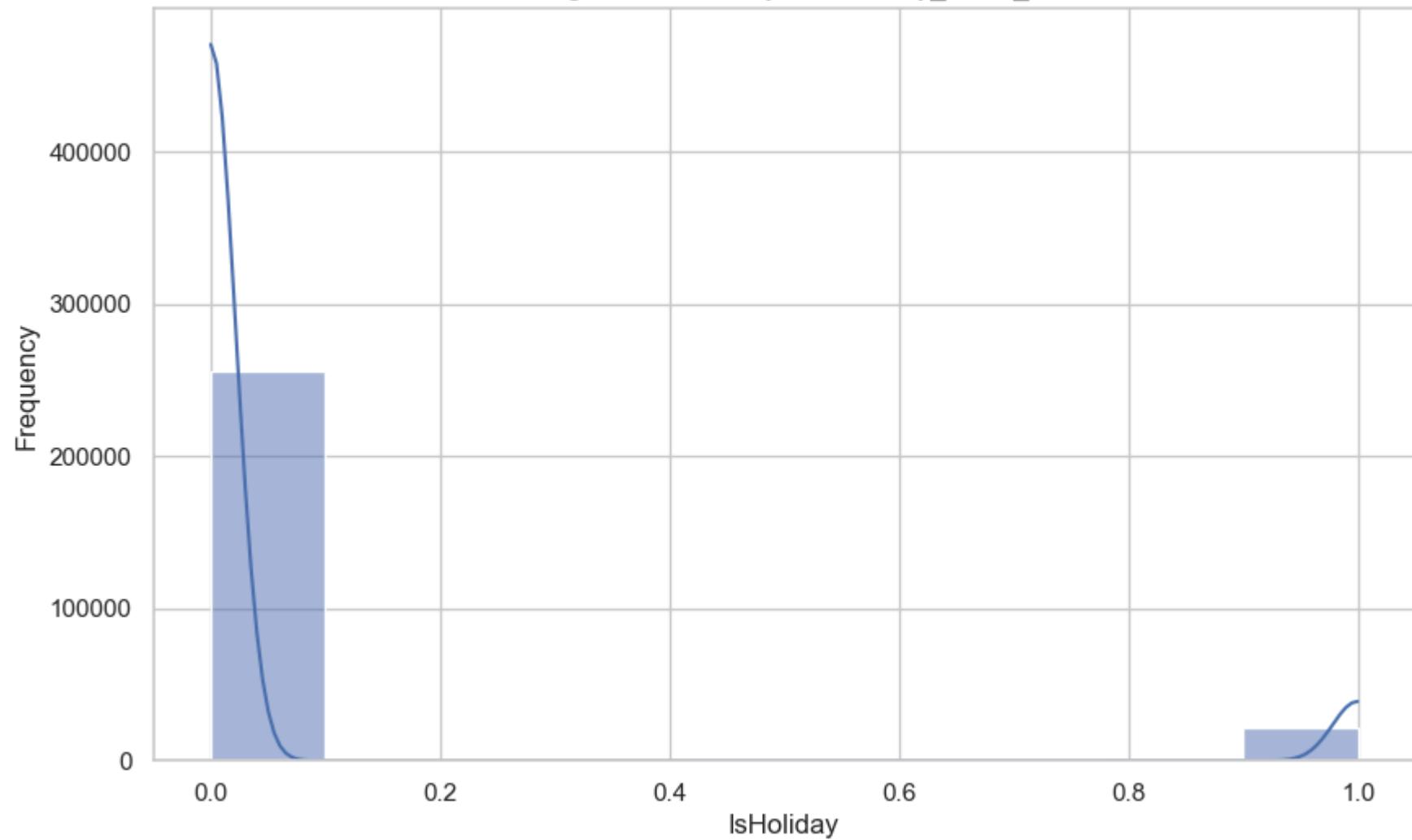


Box Plot of Weekly_Sales in Data with Weekly_Sales_9w

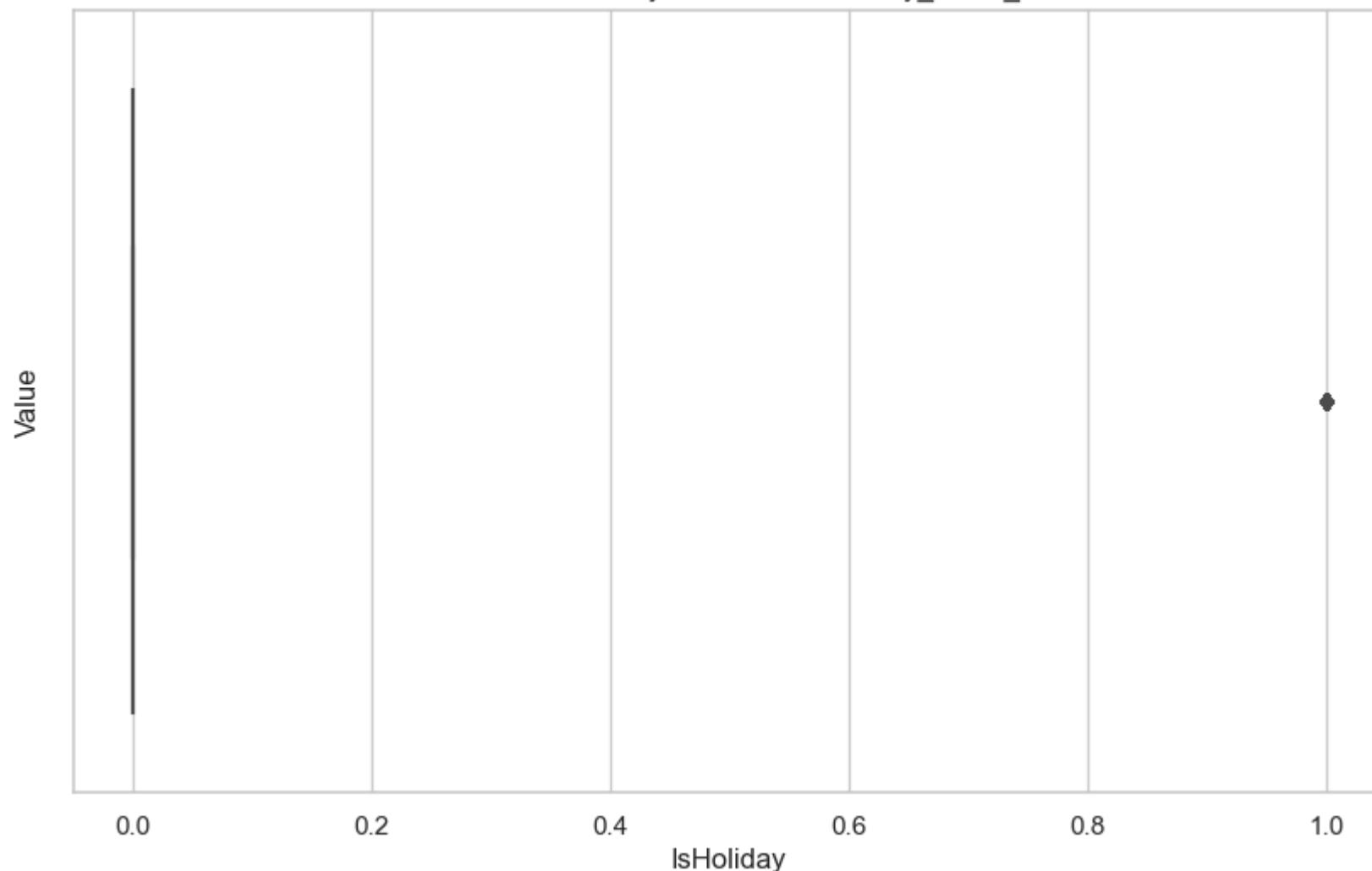


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_9w

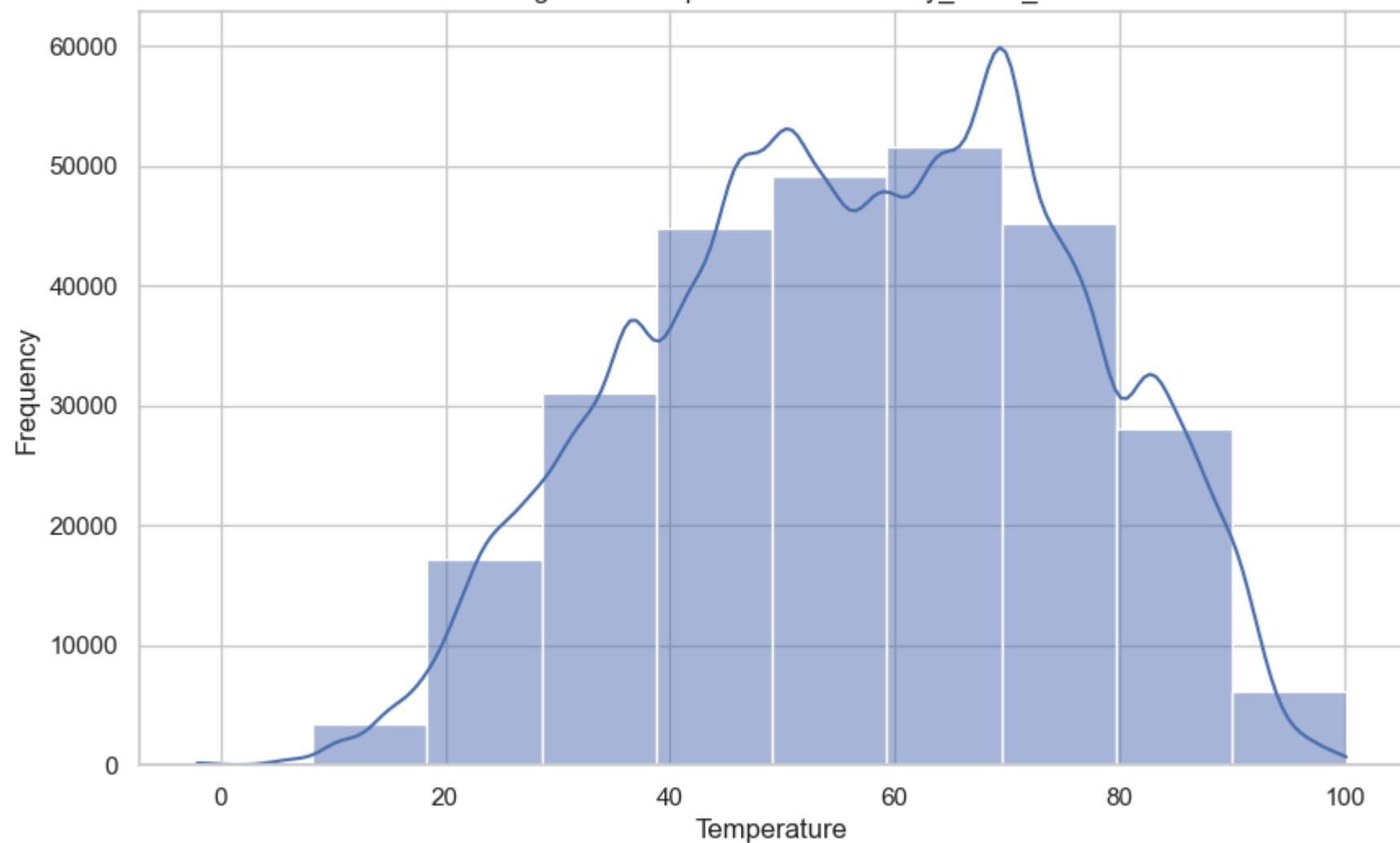


Box Plot of IsHoliday in Data with Weekly_Sales_9w

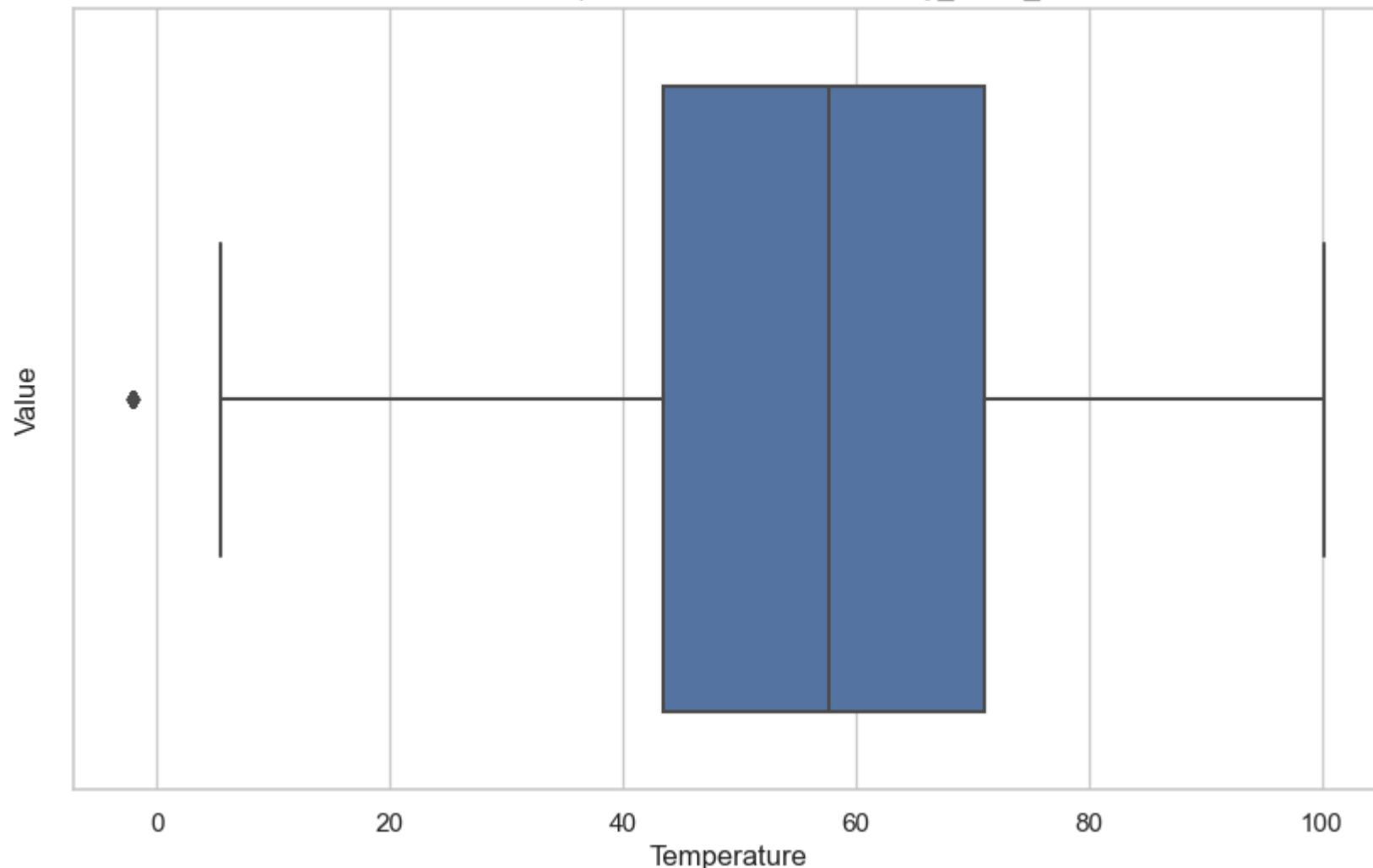


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_9w

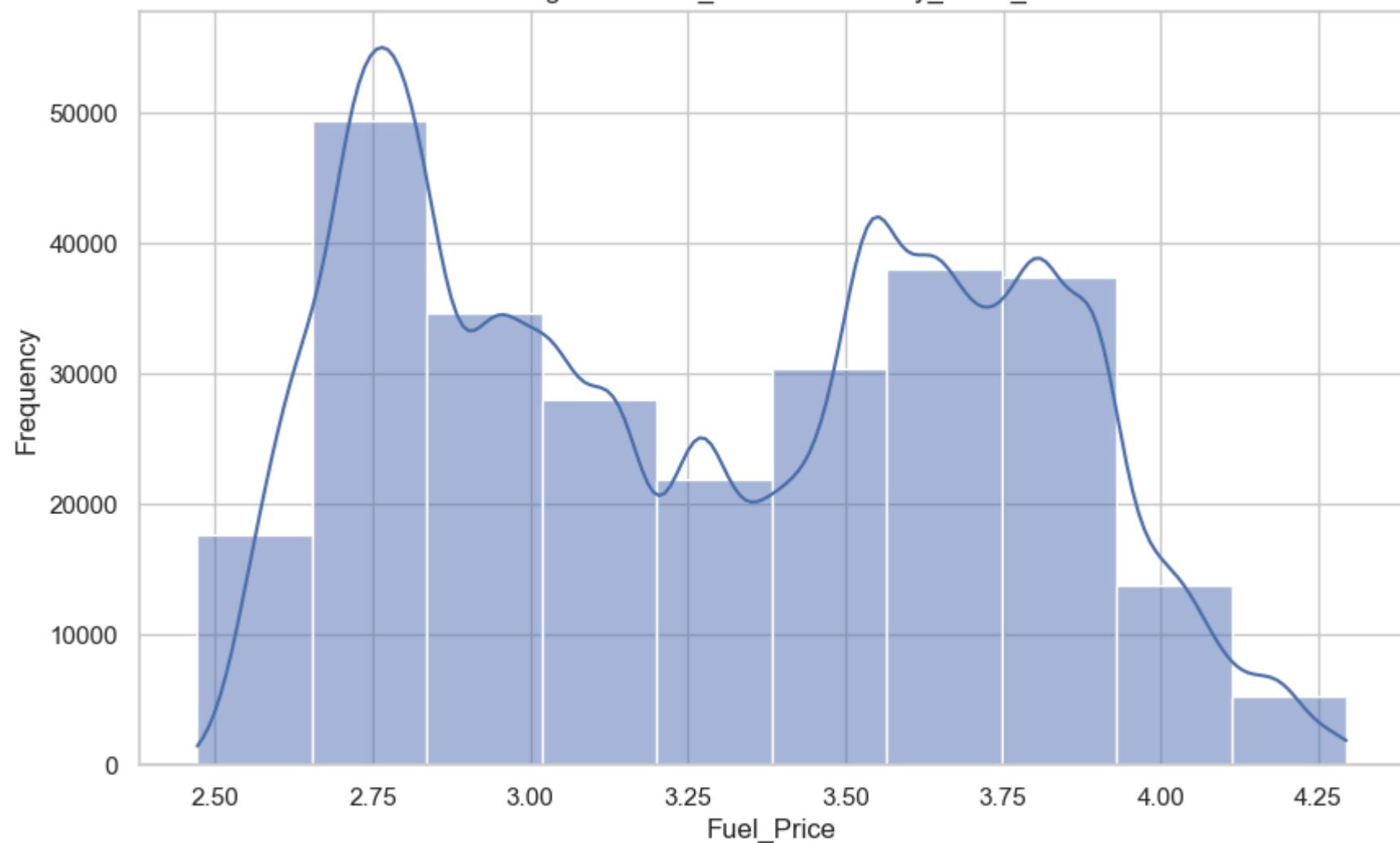


Box Plot of Temperature in Data with Weekly_Sales_9w

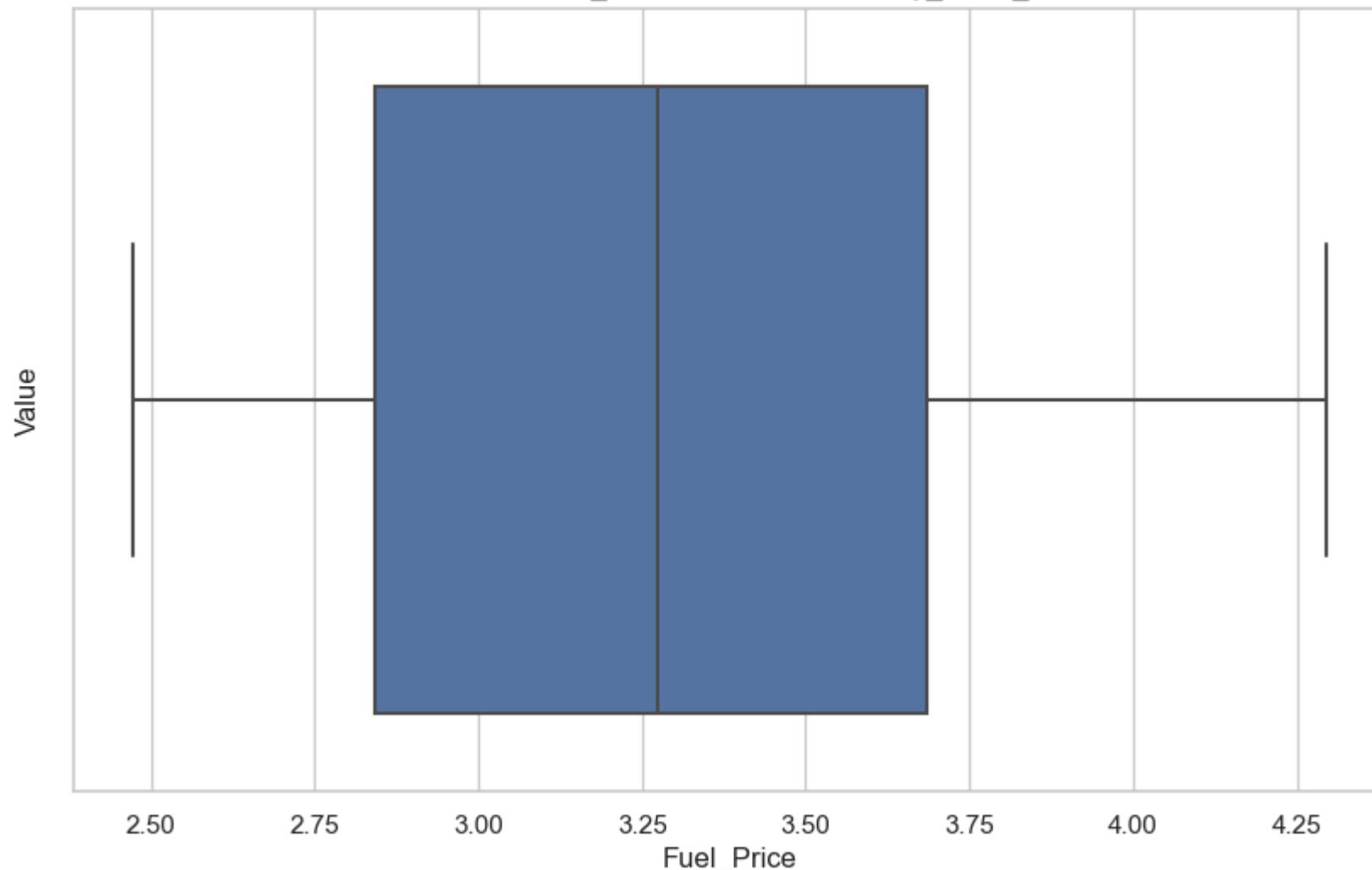


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

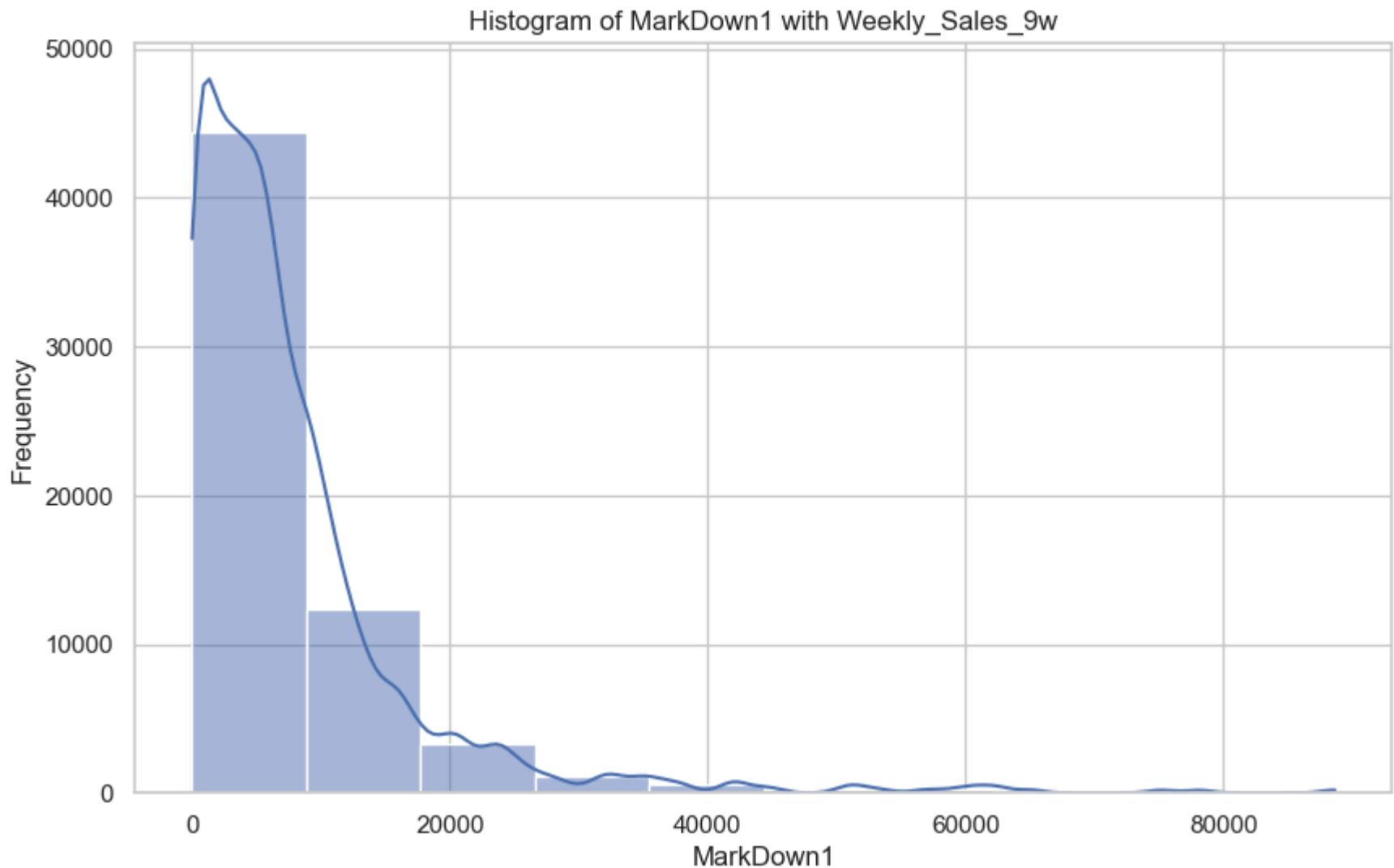
Histogram of Fuel_Price with Weekly_Sales_9w



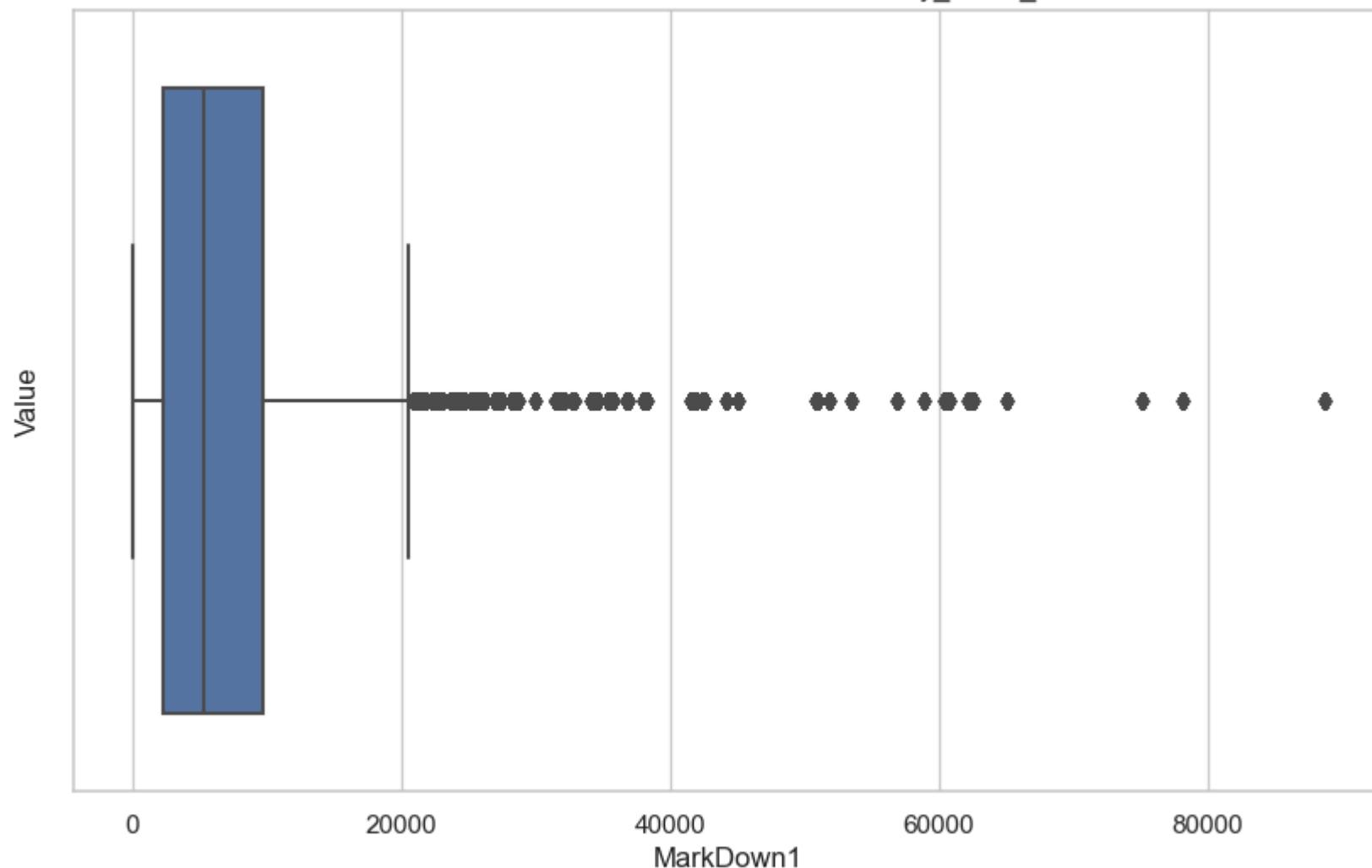
Box Plot of Fuel_Price in Data with Weekly_Sales_9w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

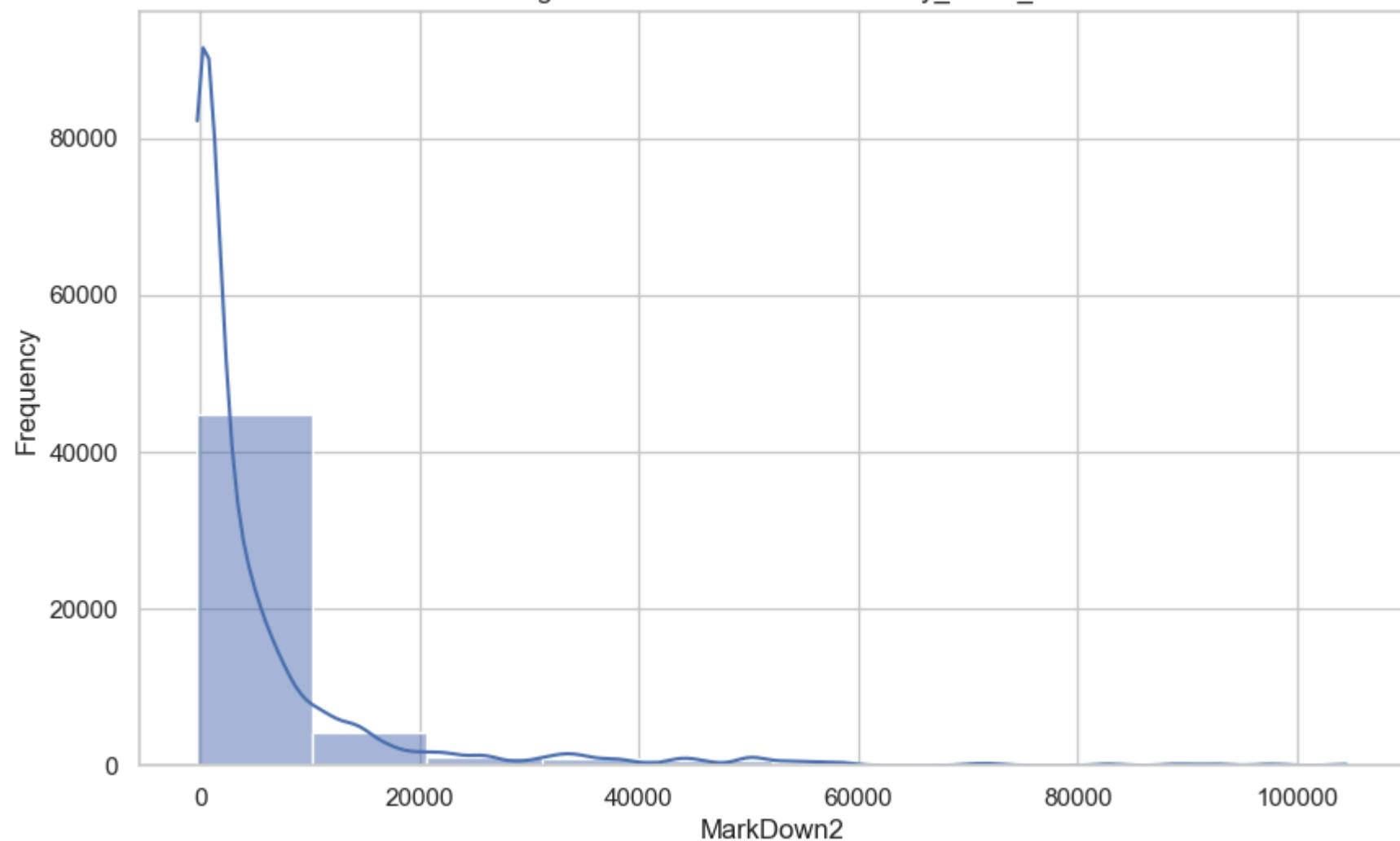


Box Plot of MarkDown1 in Data with Weekly_Sales_9w

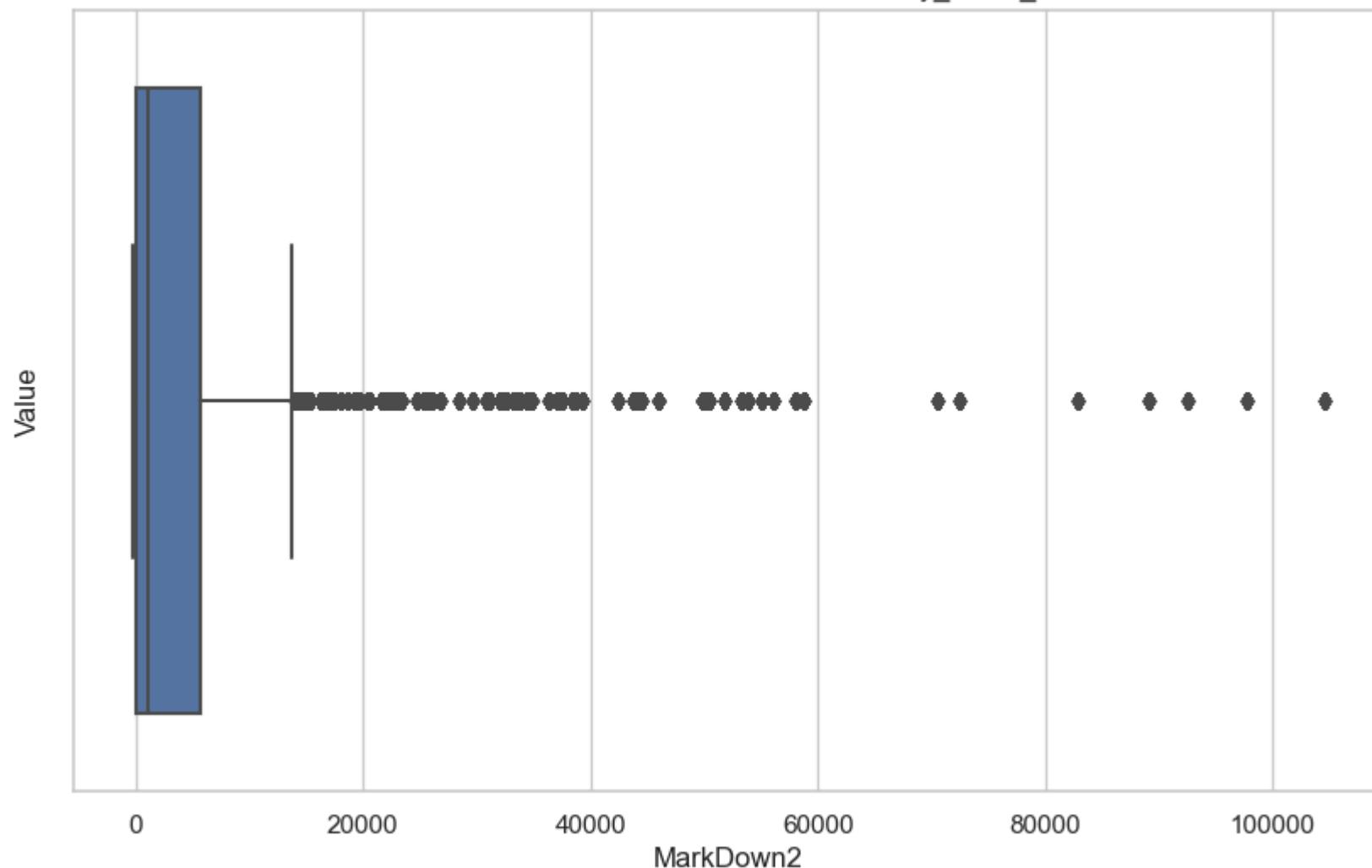


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_9w

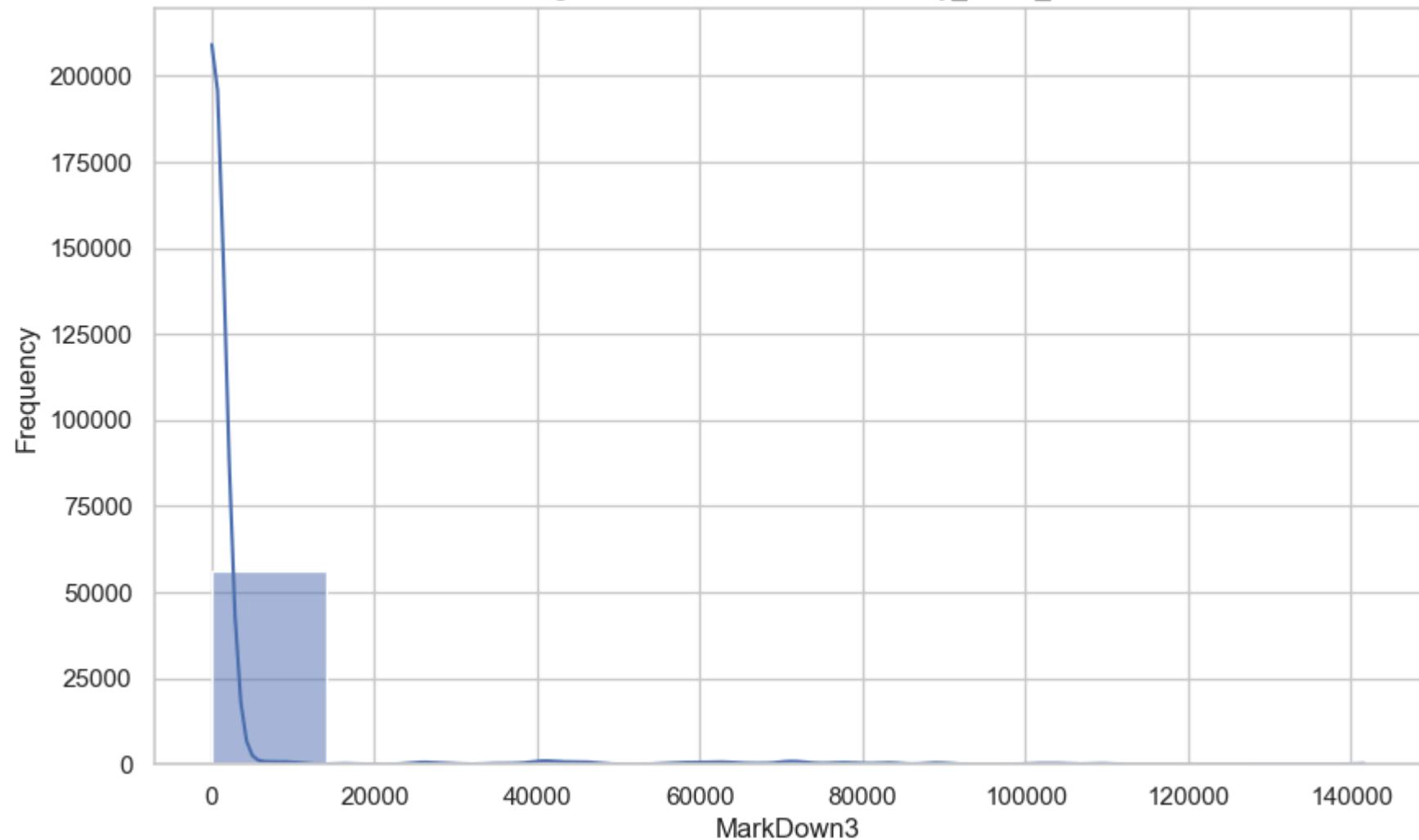


Box Plot of MarkDown2 in Data with Weekly_Sales_9w

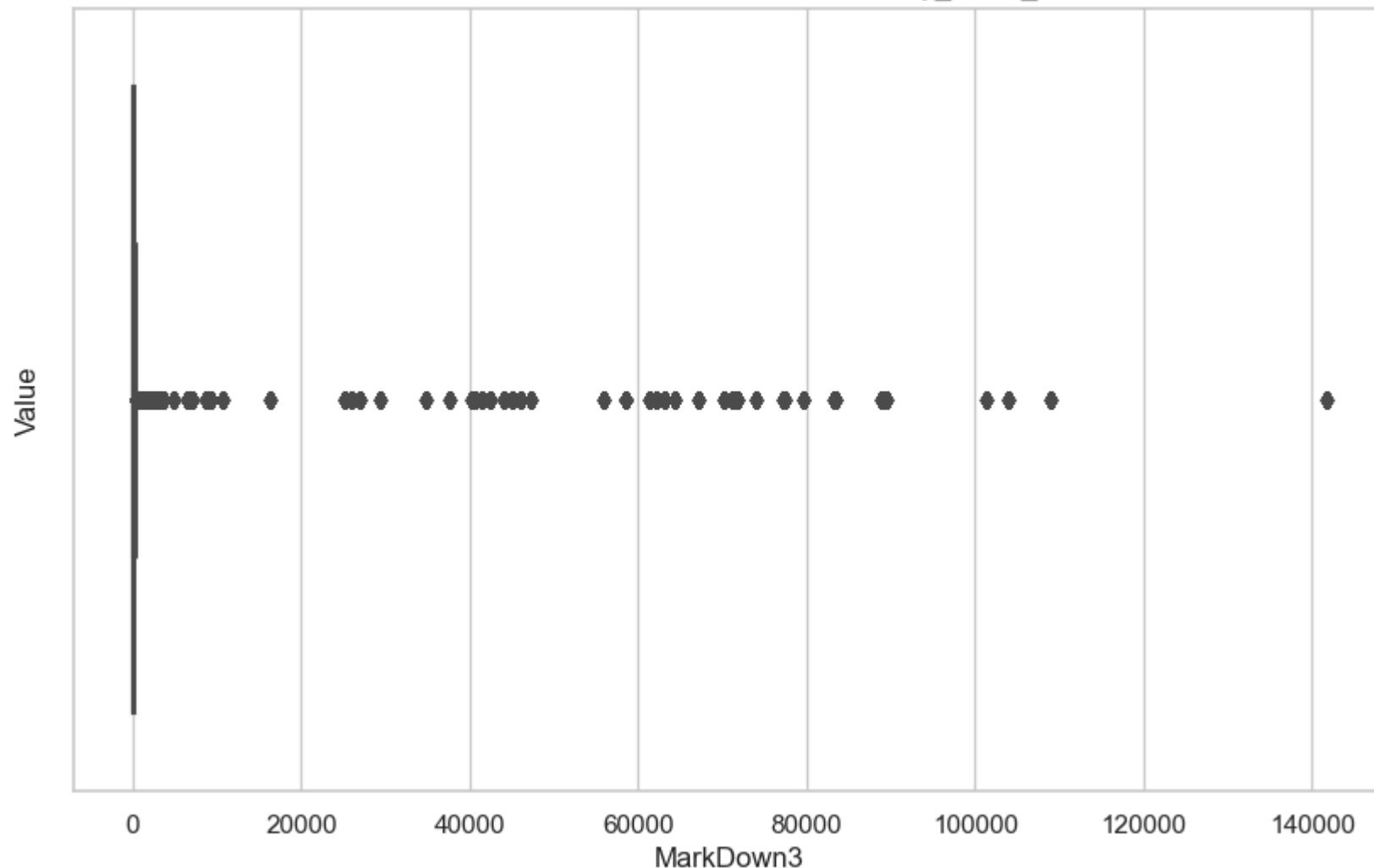


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_9w

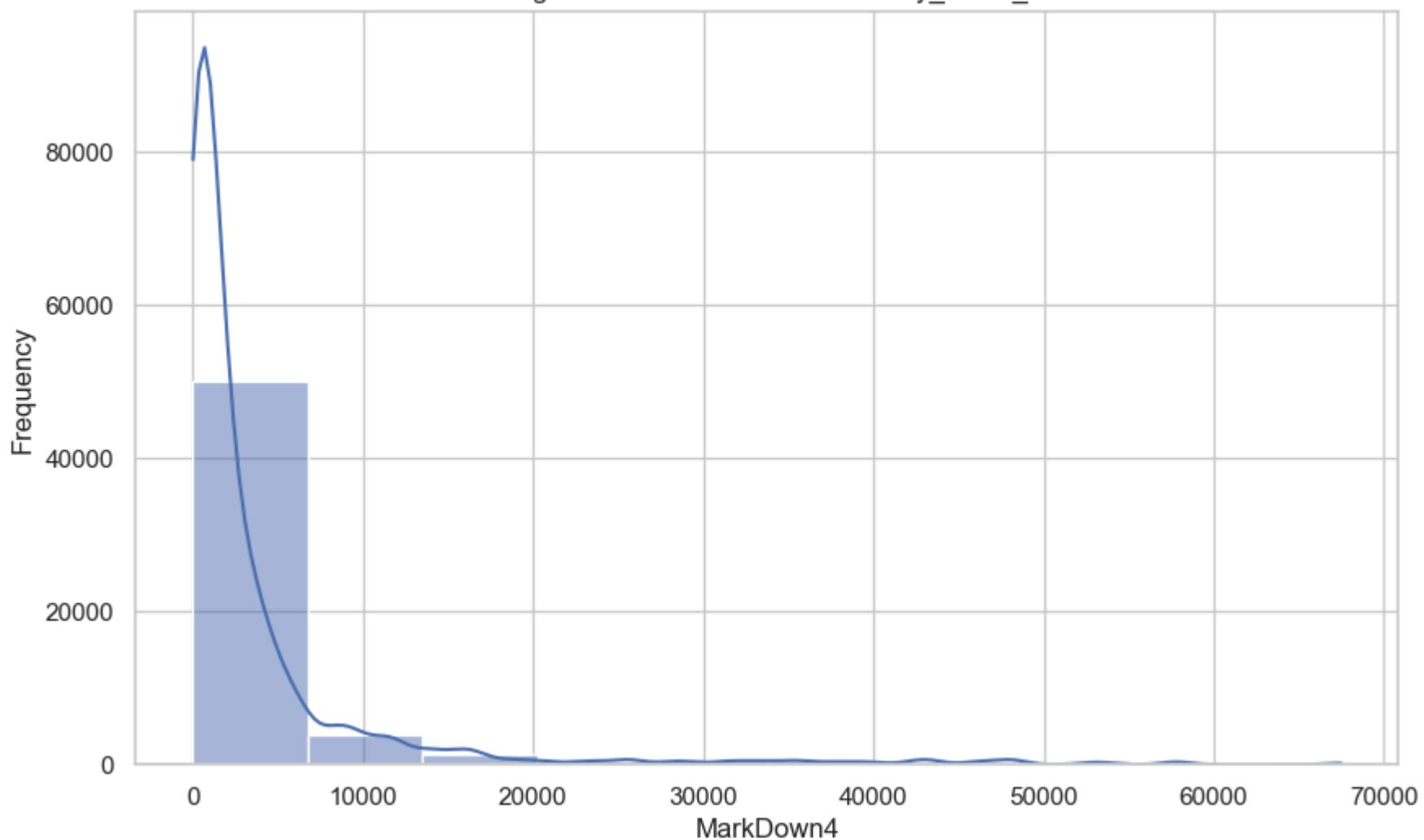


Box Plot of MarkDown3 in Data with Weekly_Sales_9w

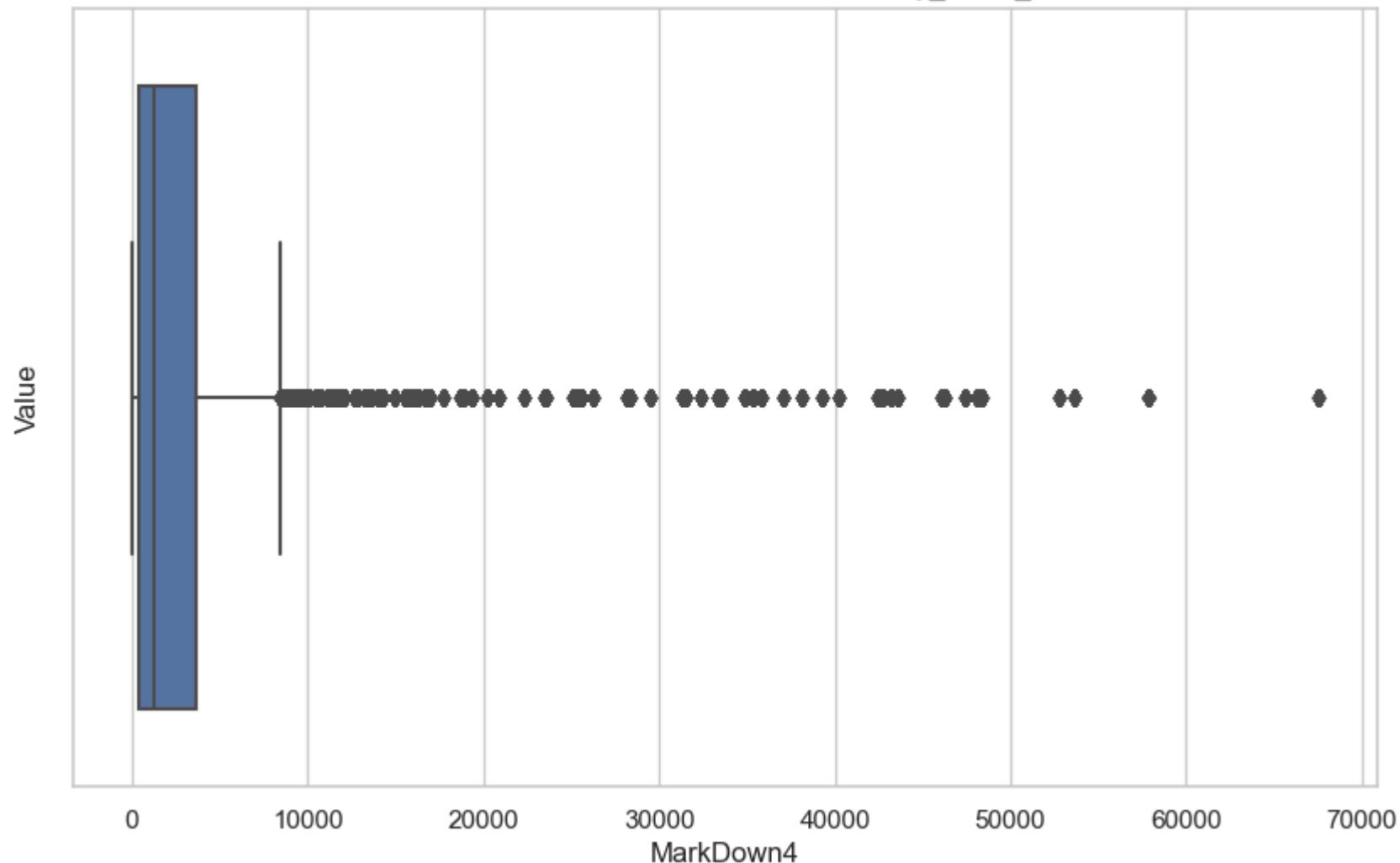


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_9w

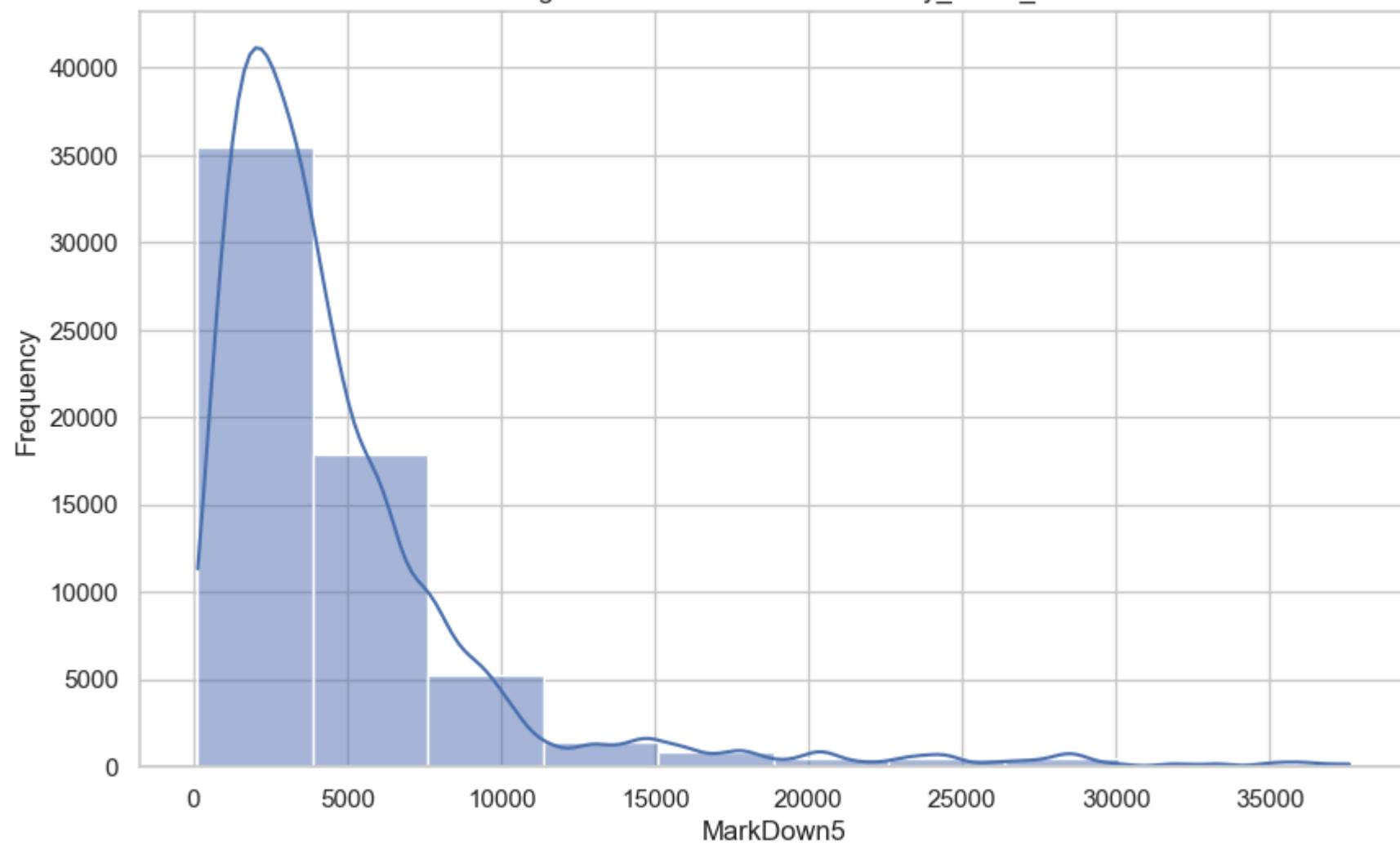


Box Plot of MarkDown4 in Data with Weekly_Sales_9w

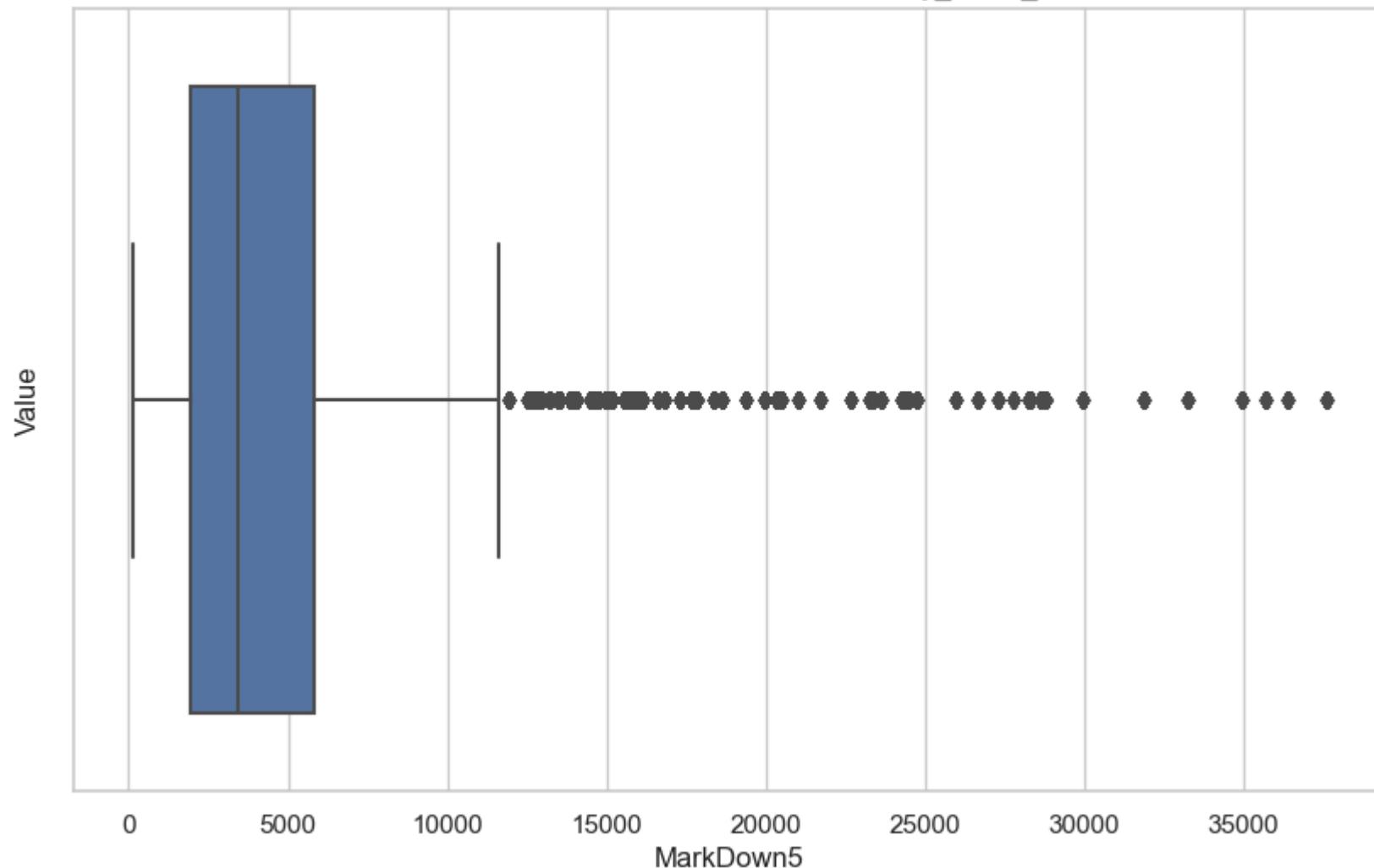


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_9w

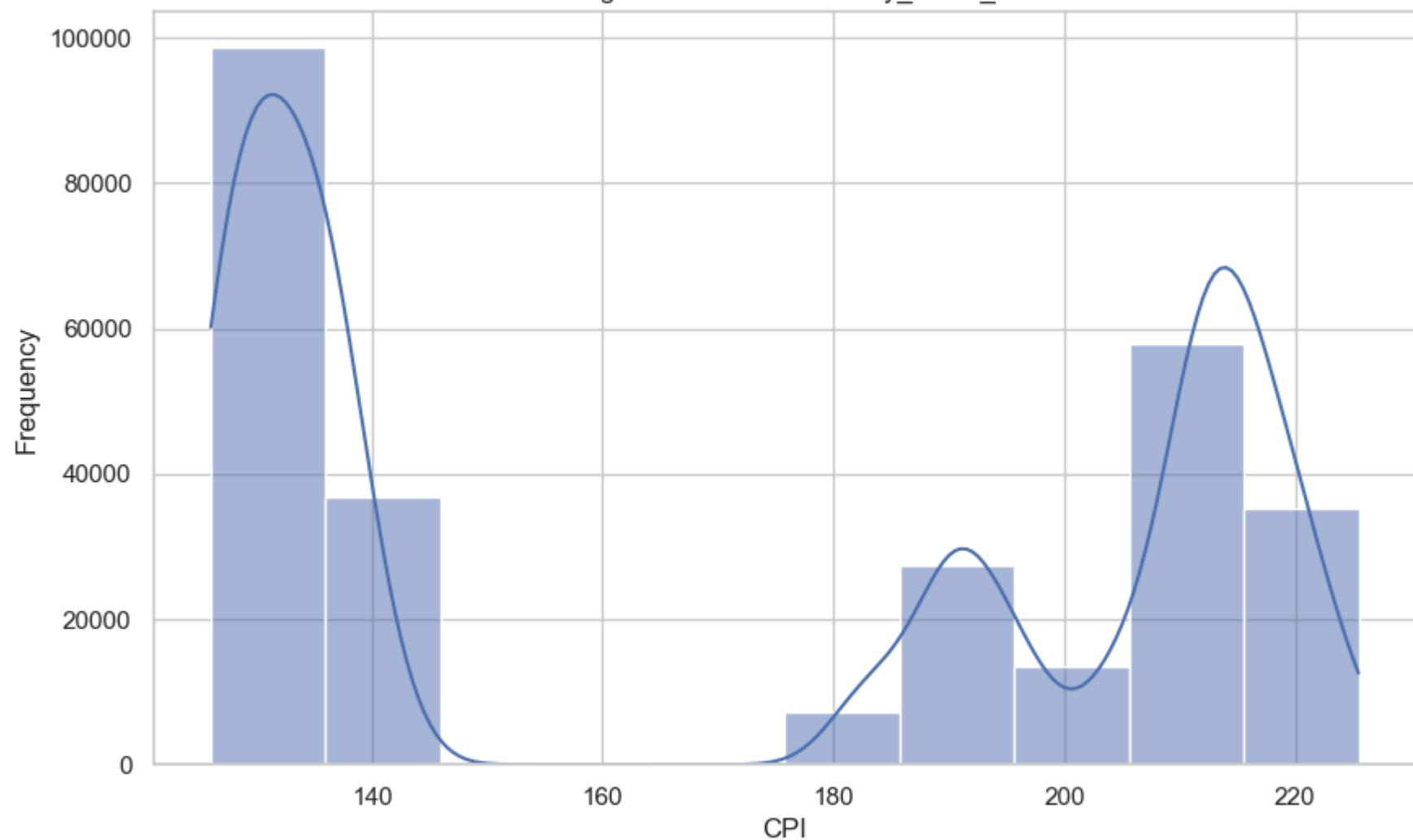


Box Plot of MarkDown5 in Data with Weekly_Sales_9w

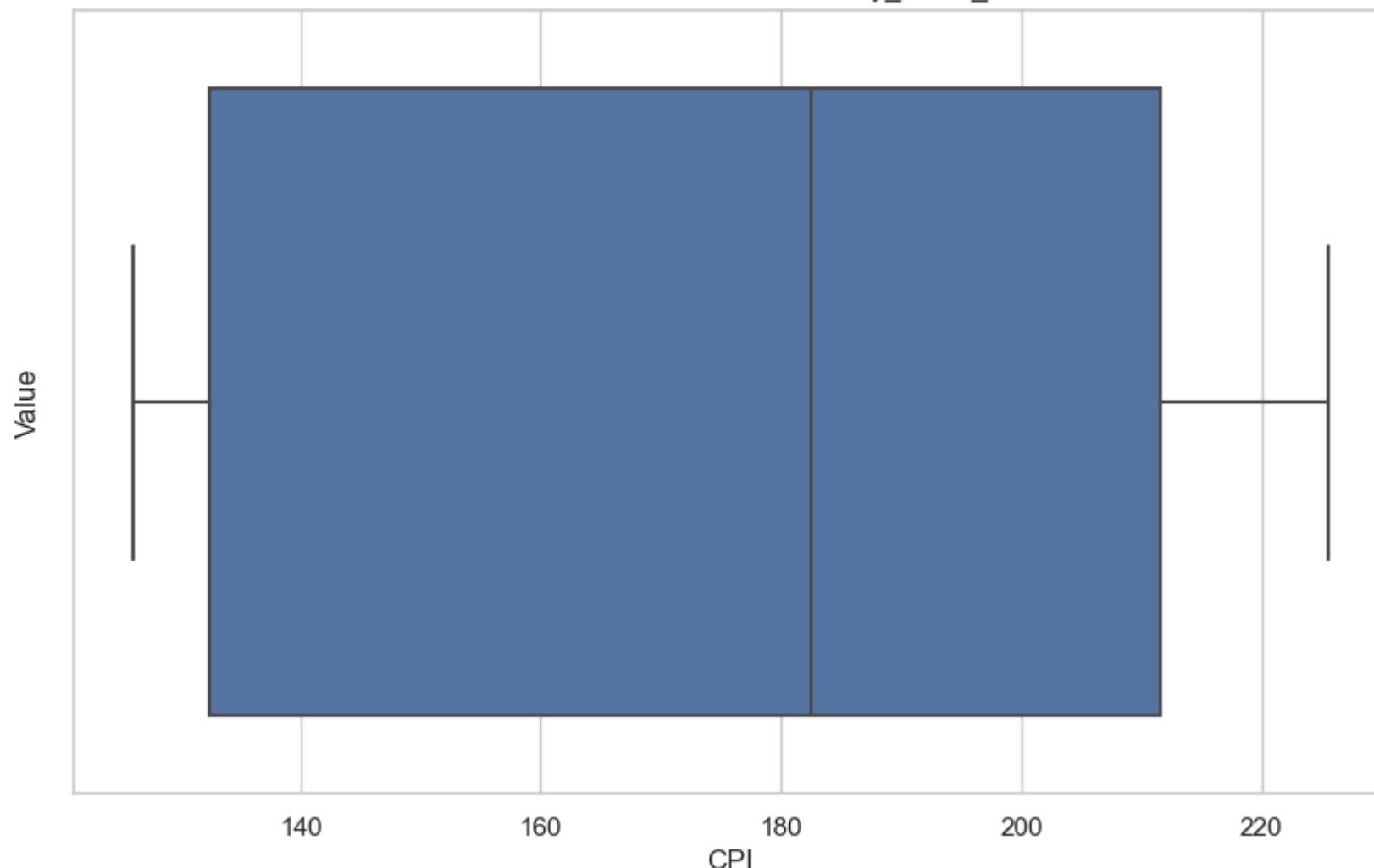


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_9w

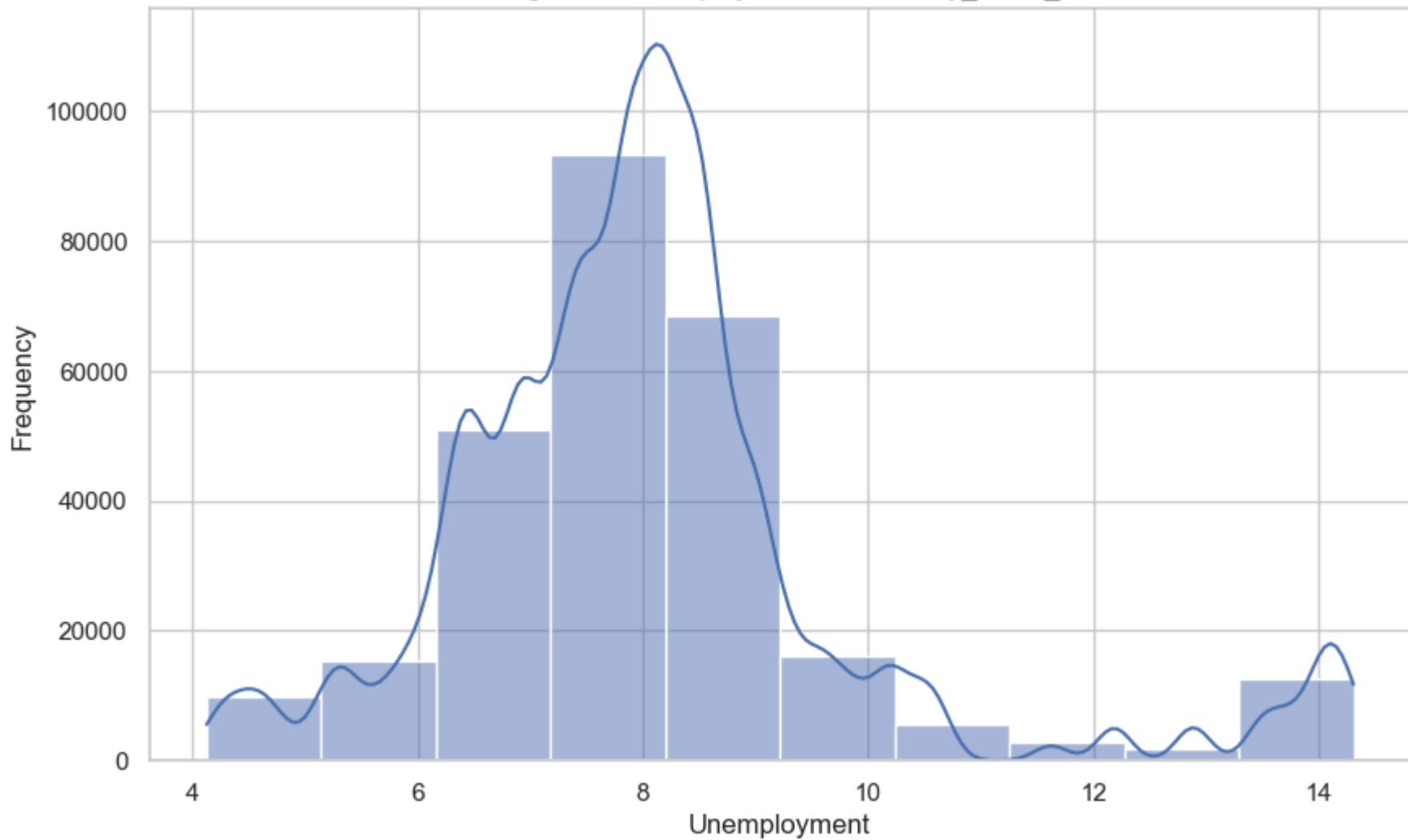


Box Plot of CPI in Data with Weekly_Sales_9w

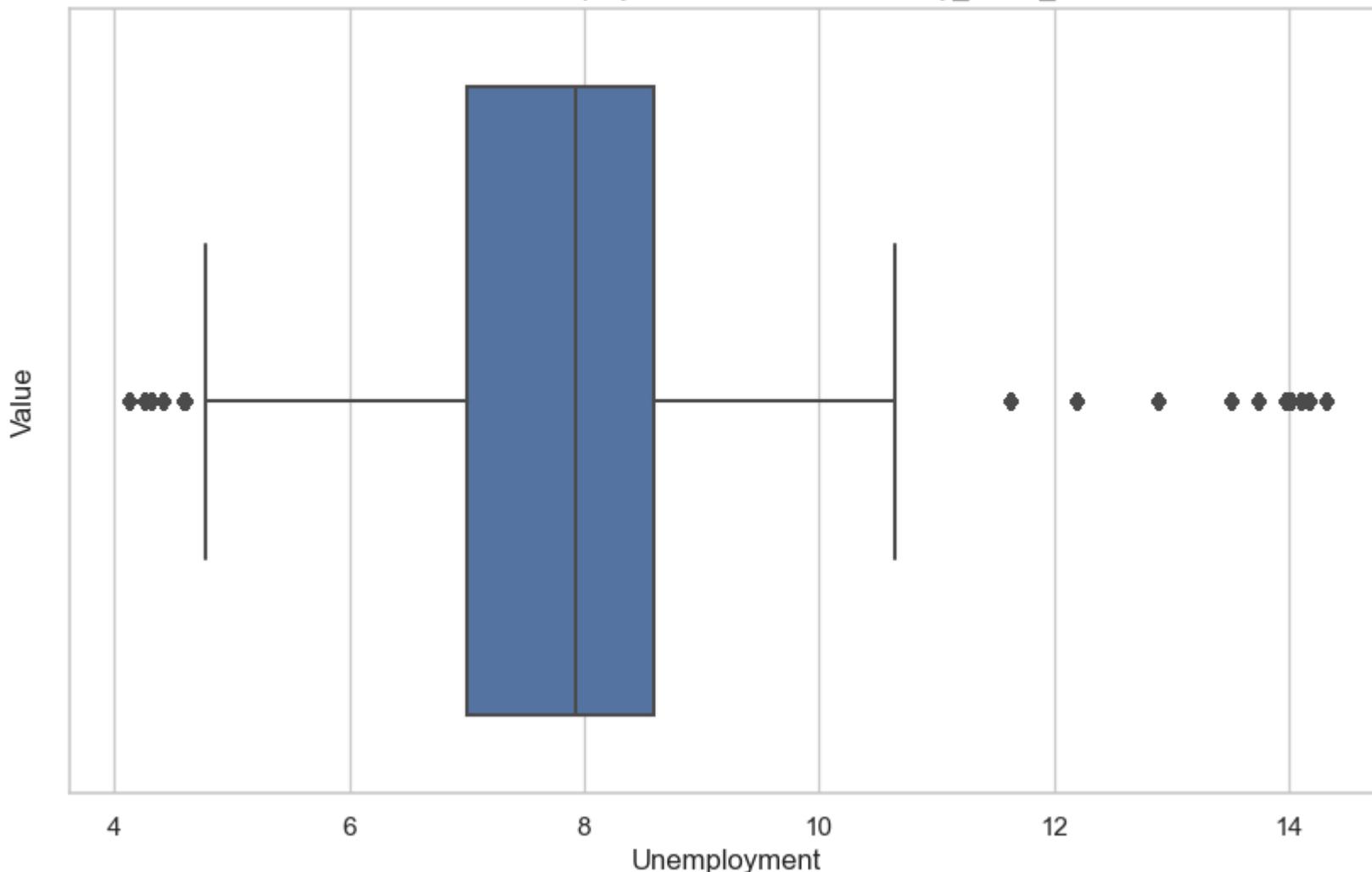


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_9w

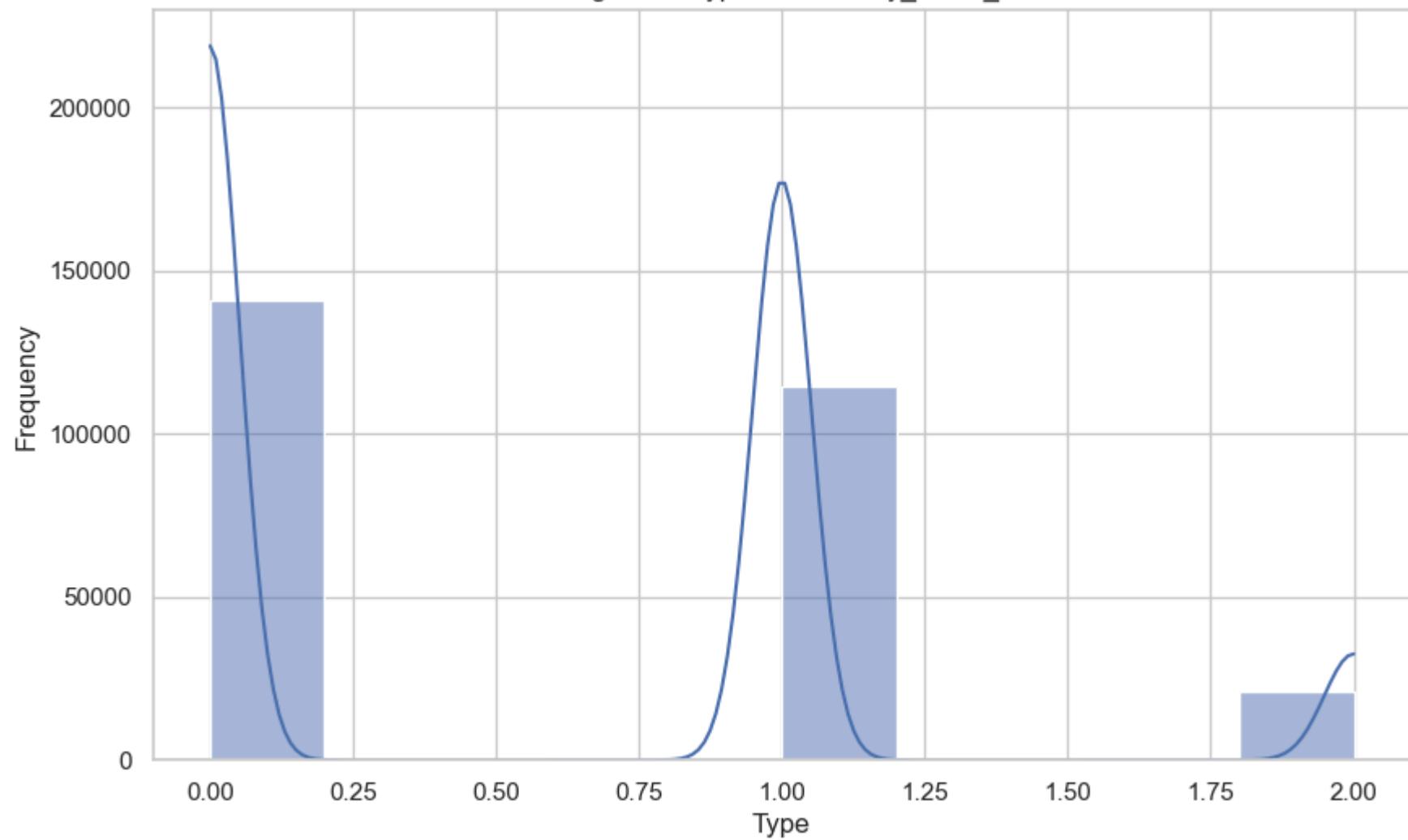


Box Plot of Unemployment in Data with Weekly_Sales_9w

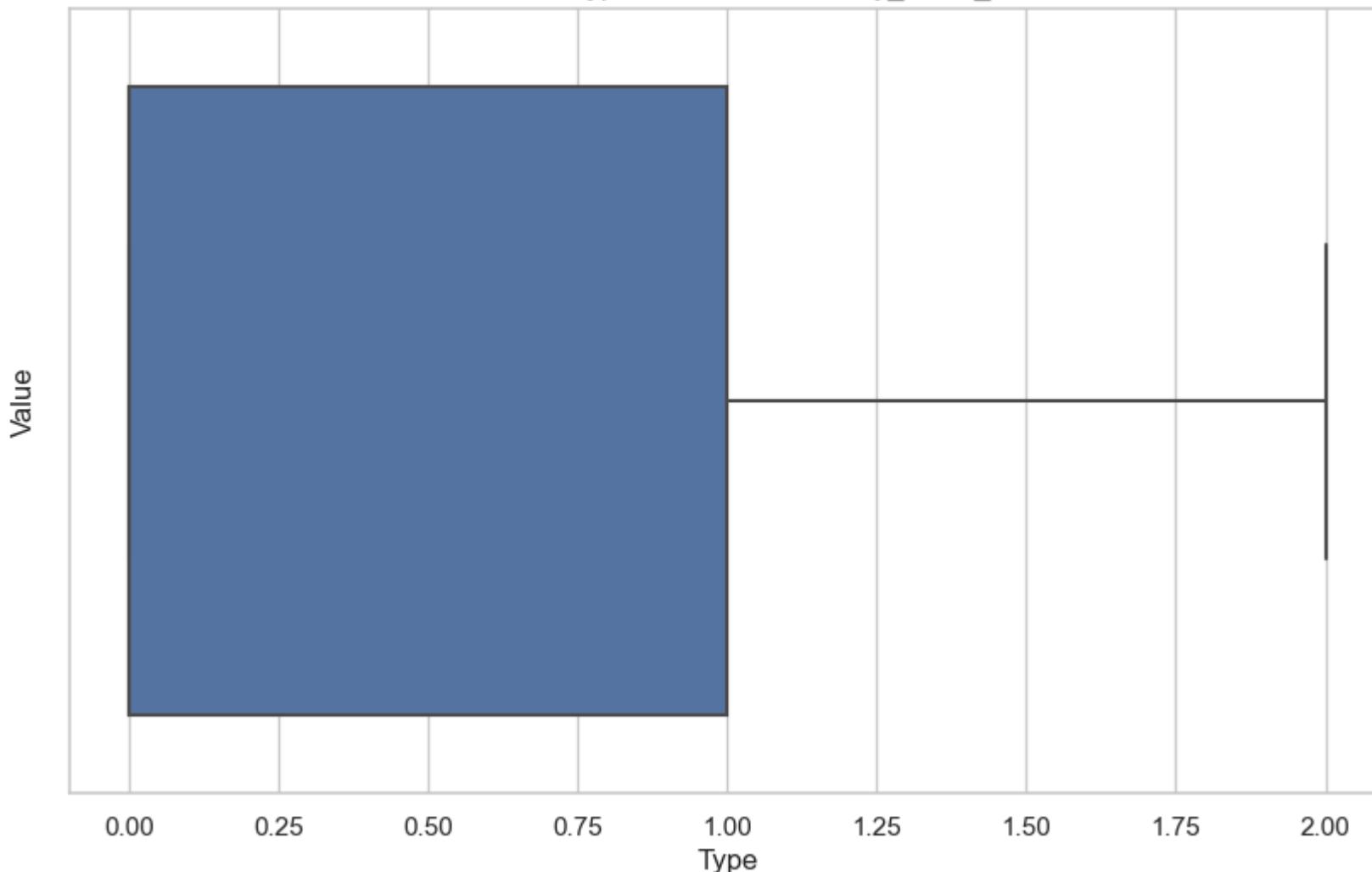


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_9w

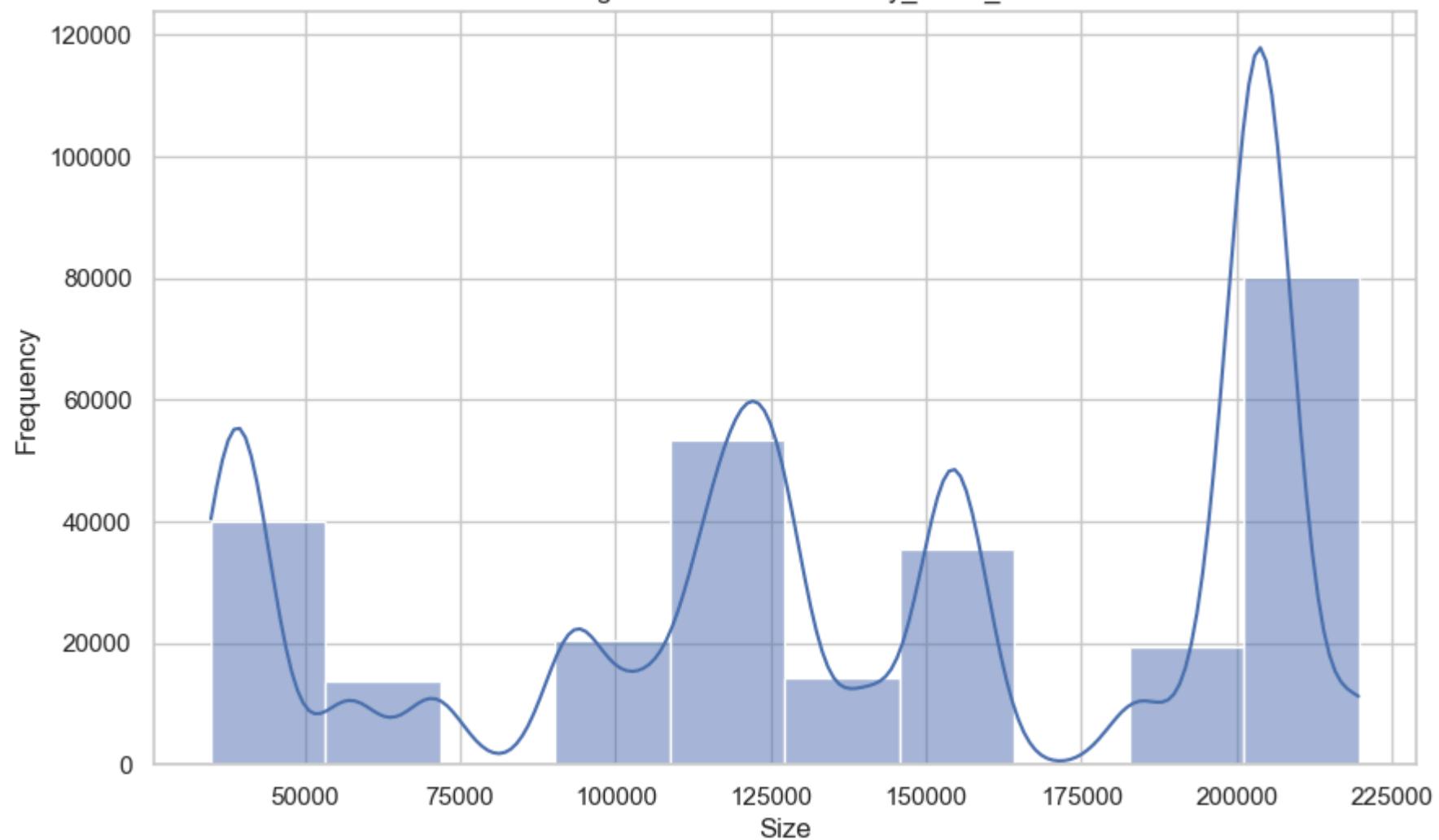


Box Plot of Type in Data with Weekly_Sales_9w

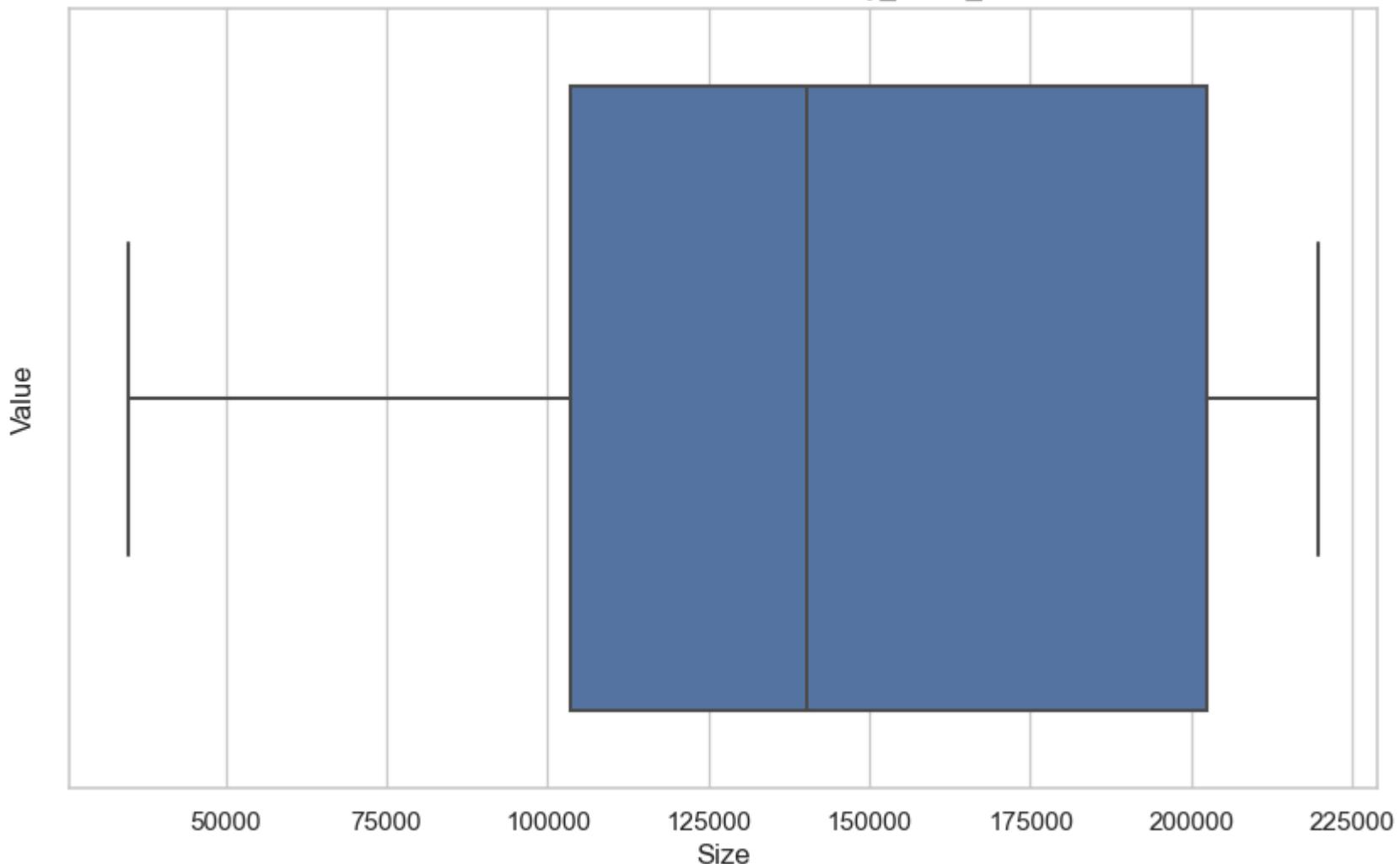


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_9w

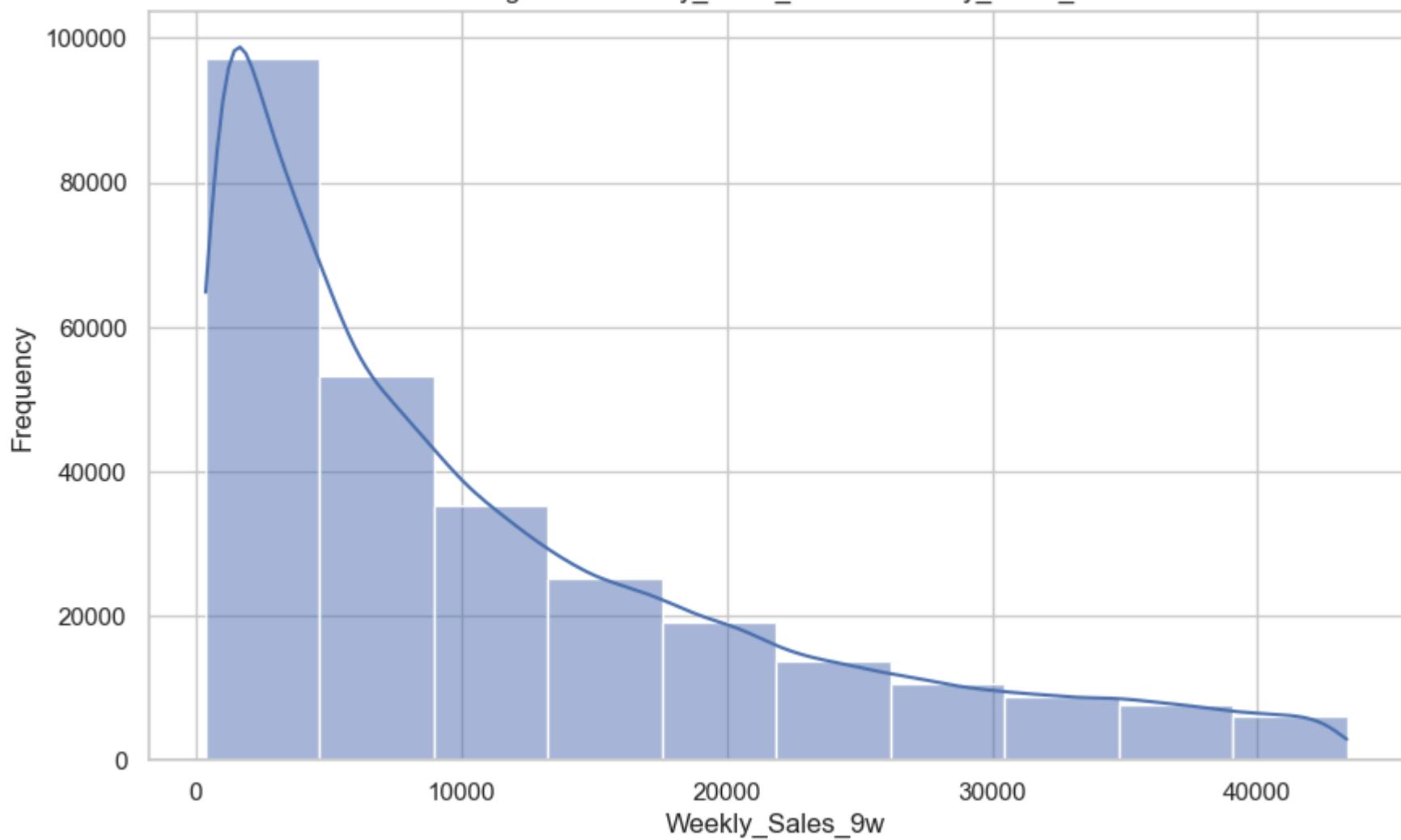


Box Plot of Size in Data with Weekly_Sales_9w

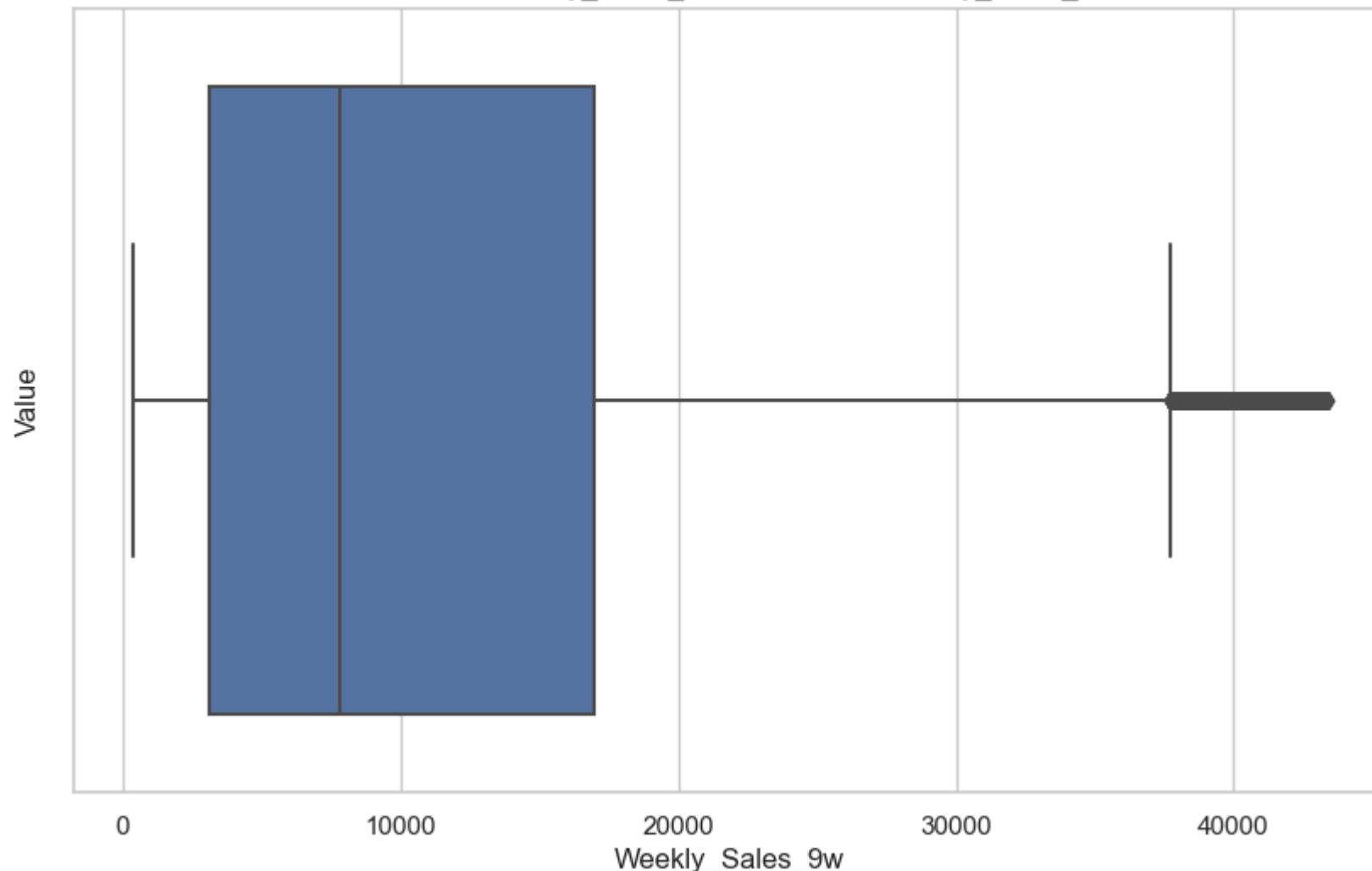


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_9w with Weekly_Sales_9w

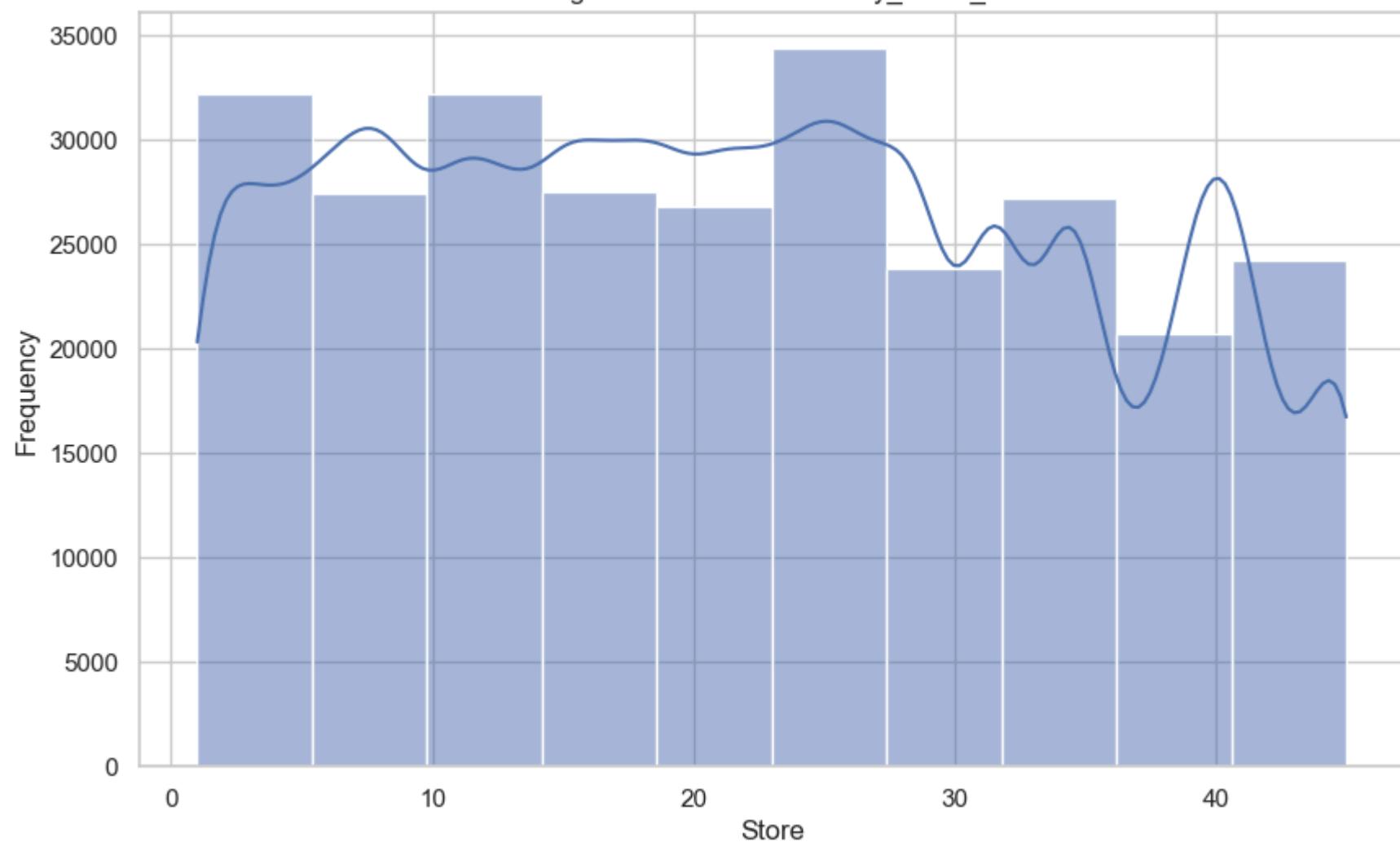


Box Plot of Weekly_Sales_9w in Data with Weekly_Sales_9w

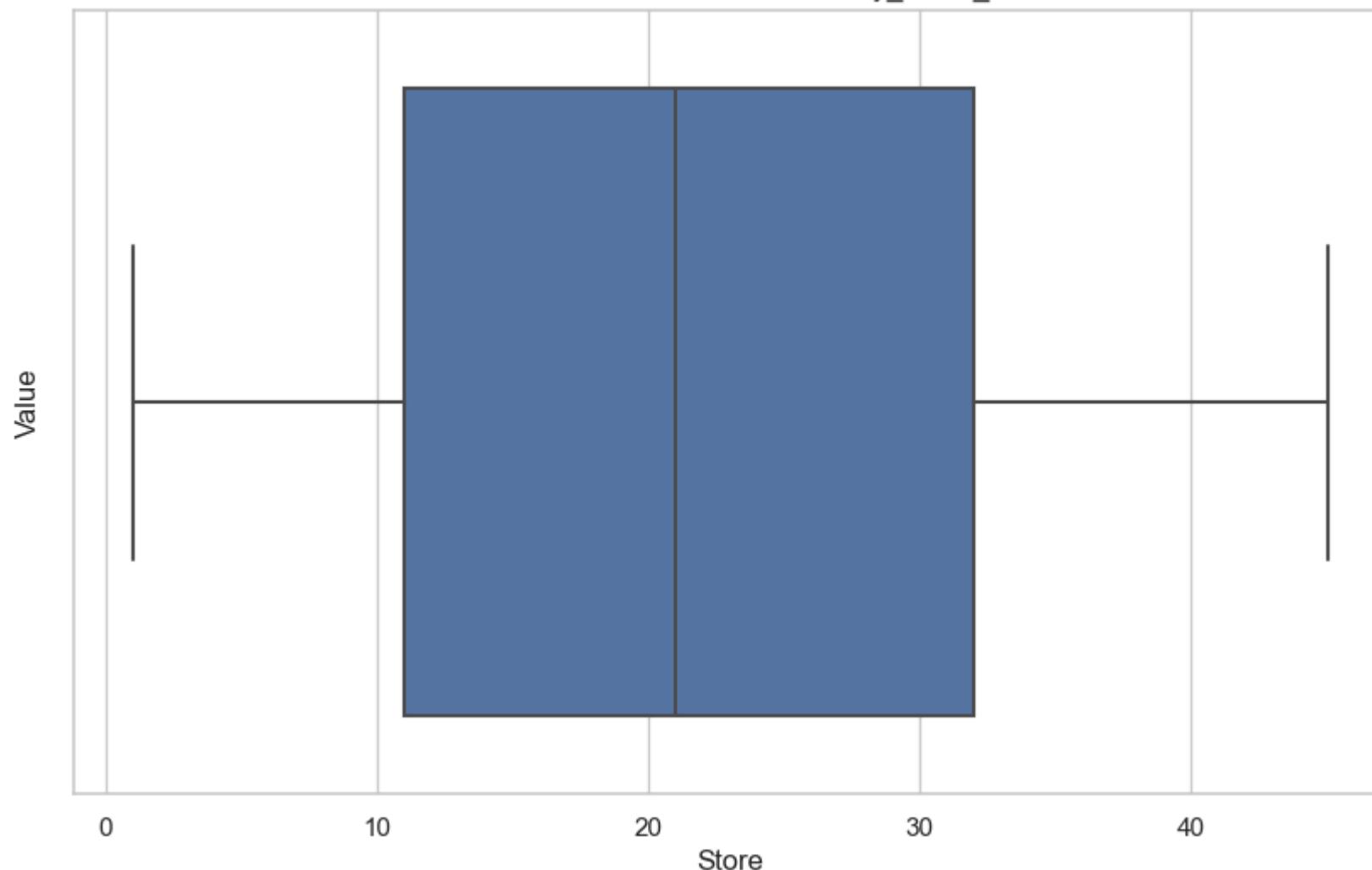


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_10w

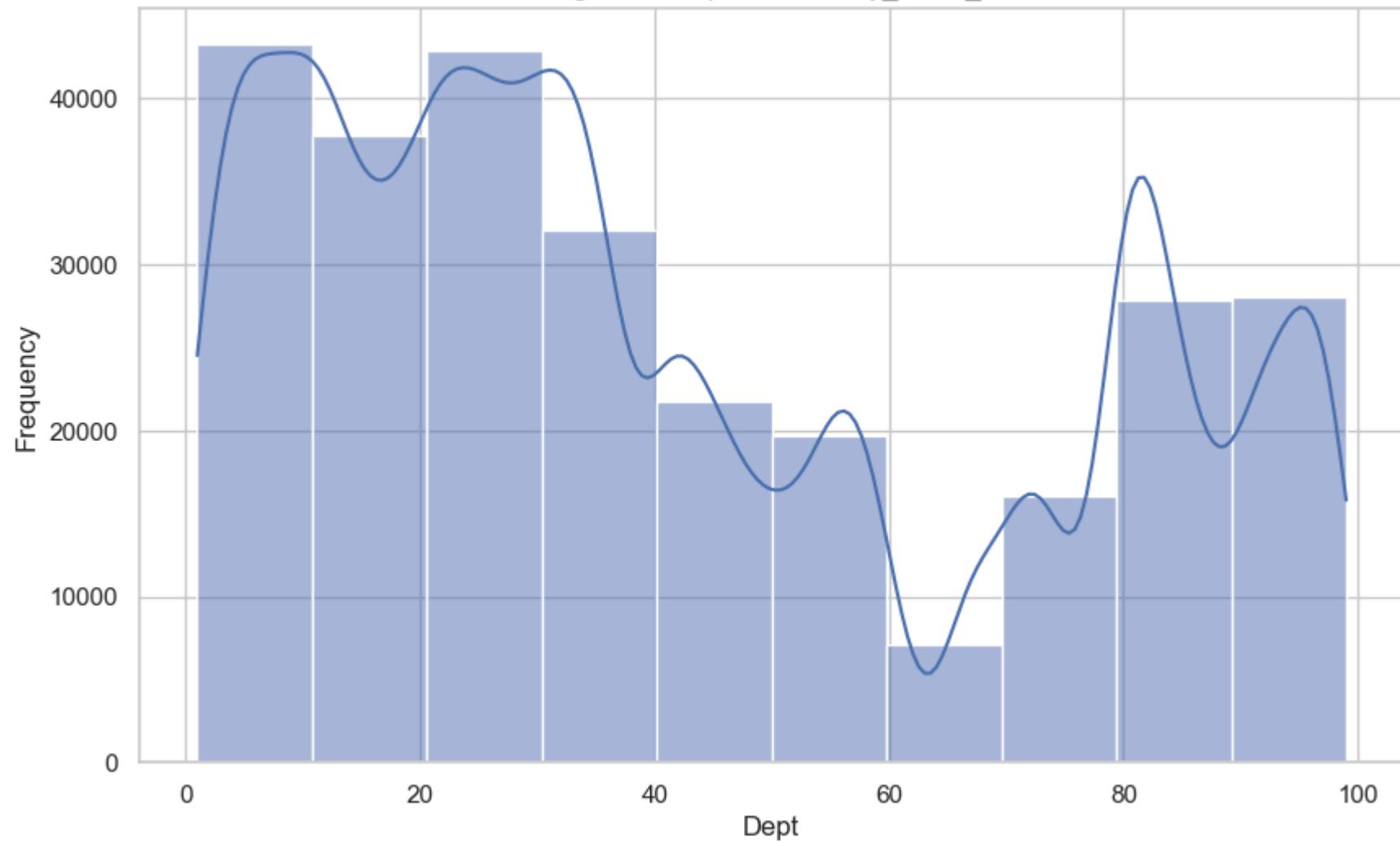


Box Plot of Store in Data with Weekly_Sales_10w

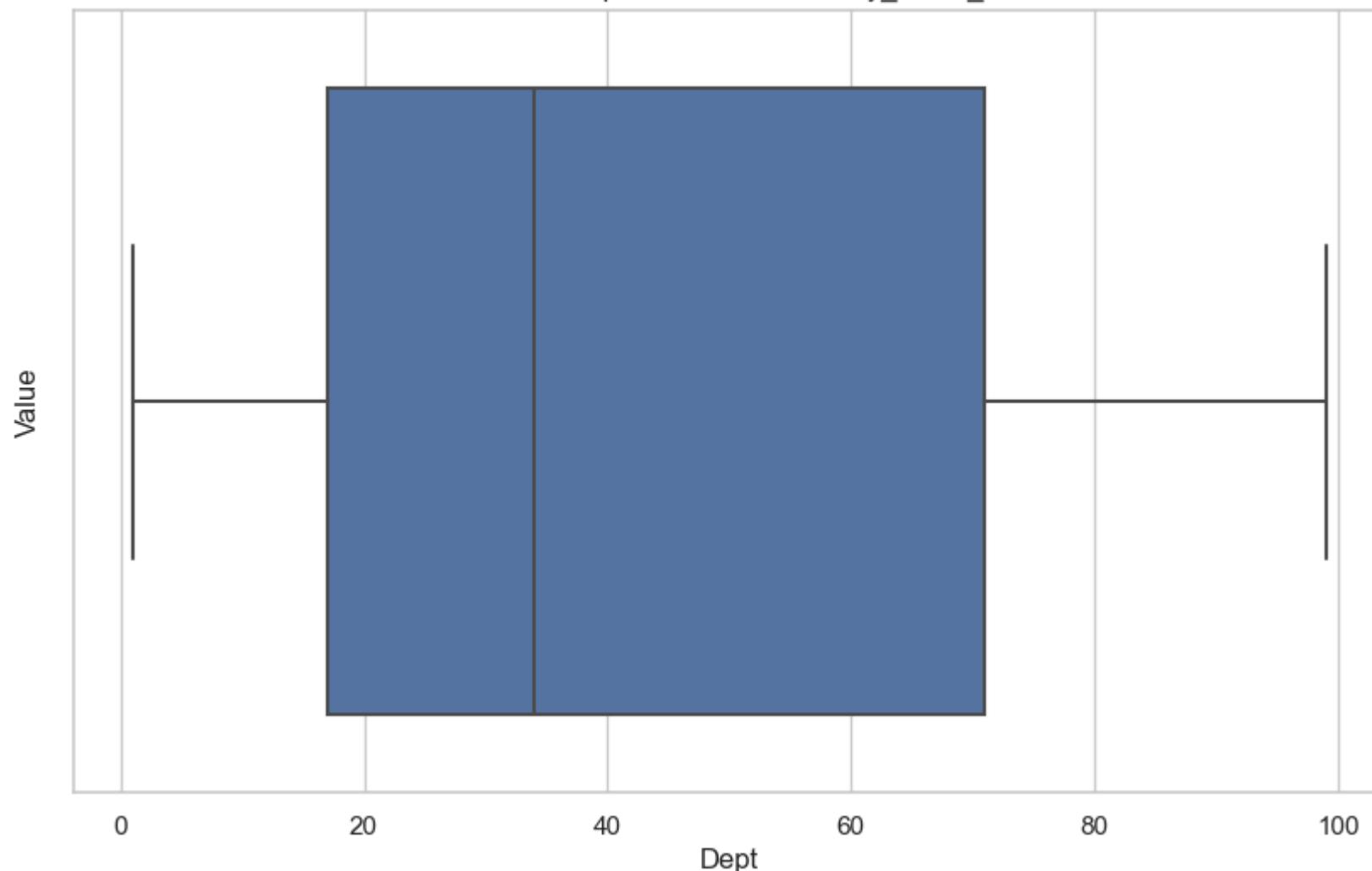


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Dept with Weekly_Sales_10w

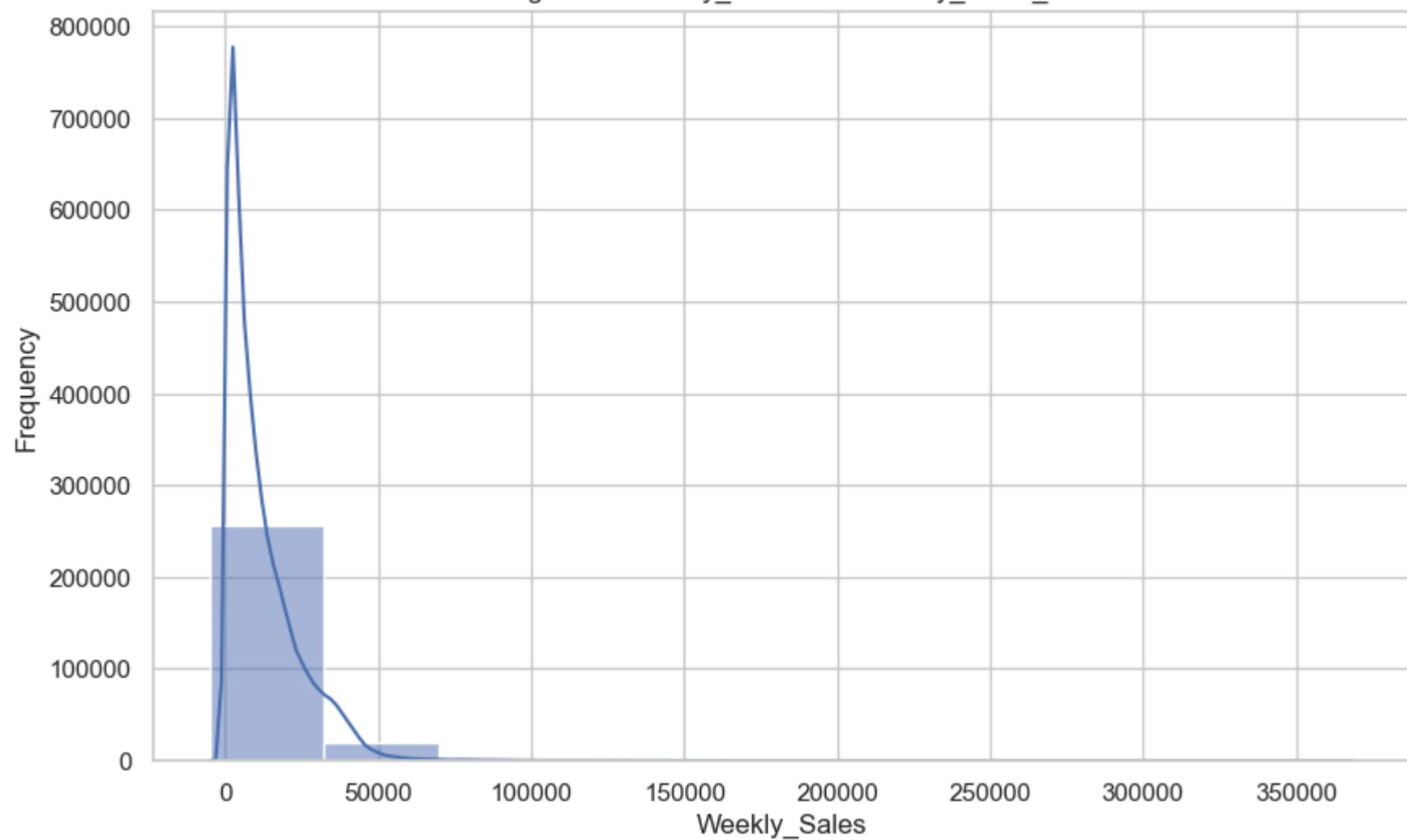


Box Plot of Dept in Data with Weekly_Sales_10w

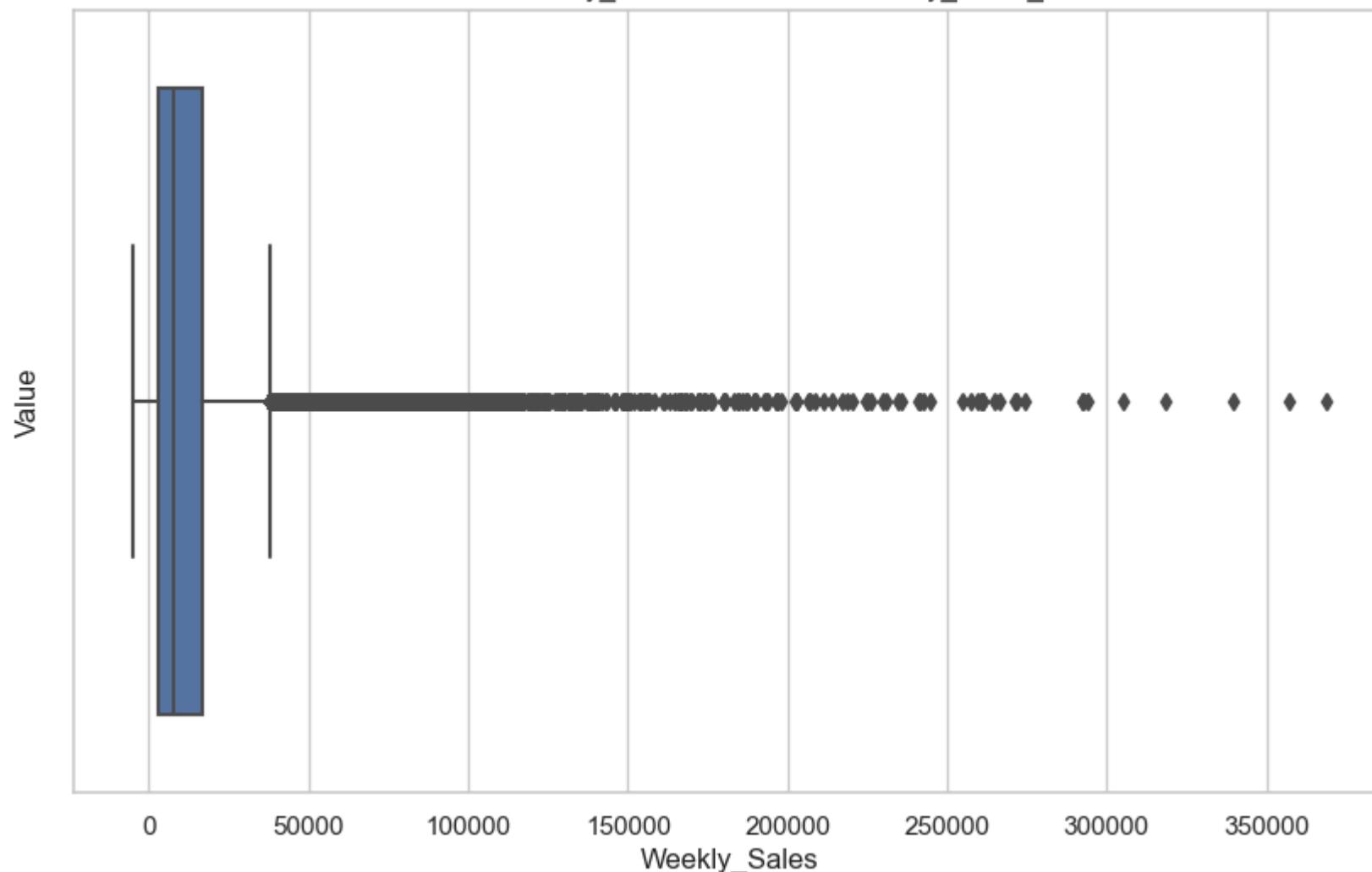


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales with Weekly_Sales_10w

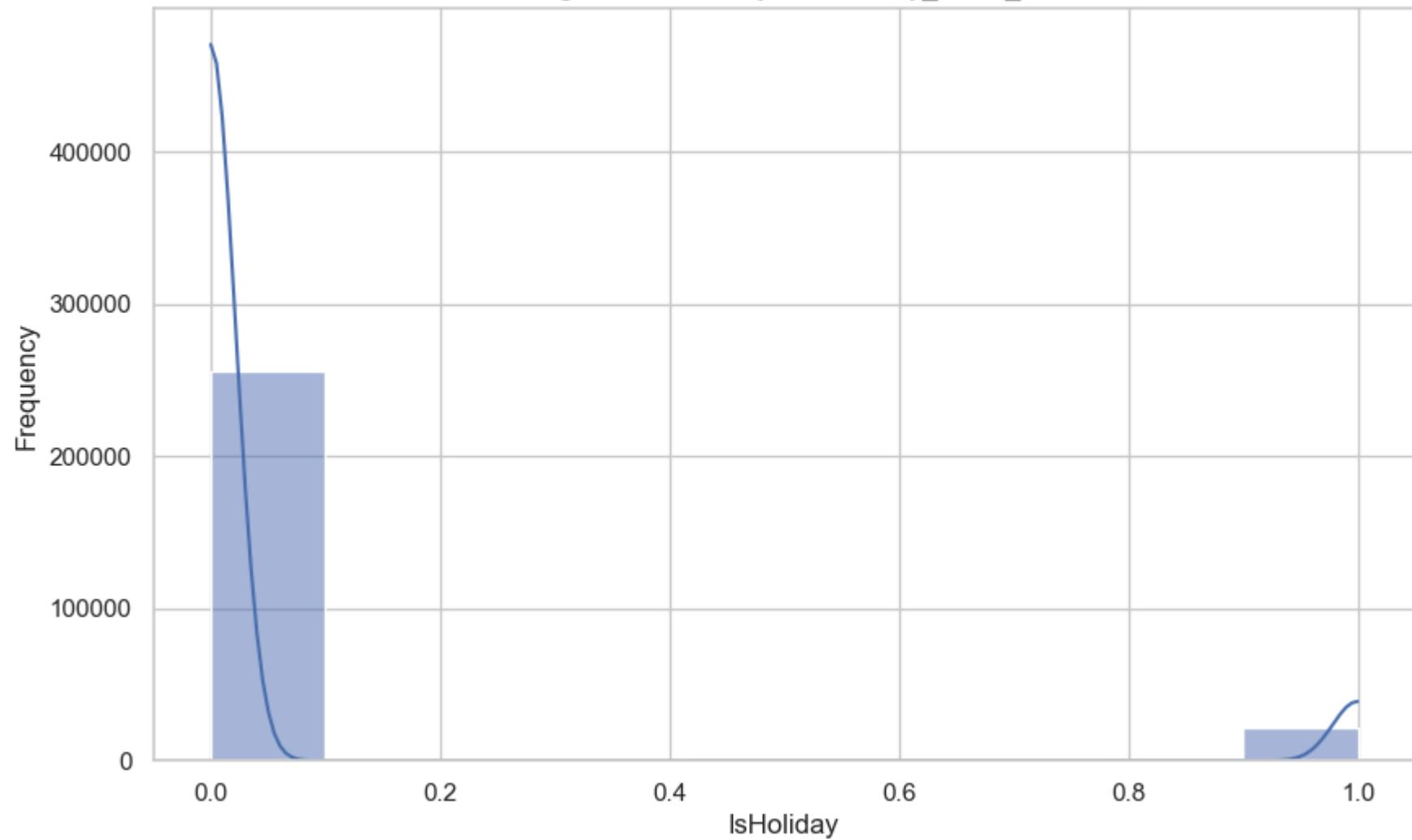


Box Plot of Weekly_Sales in Data with Weekly_Sales_10w

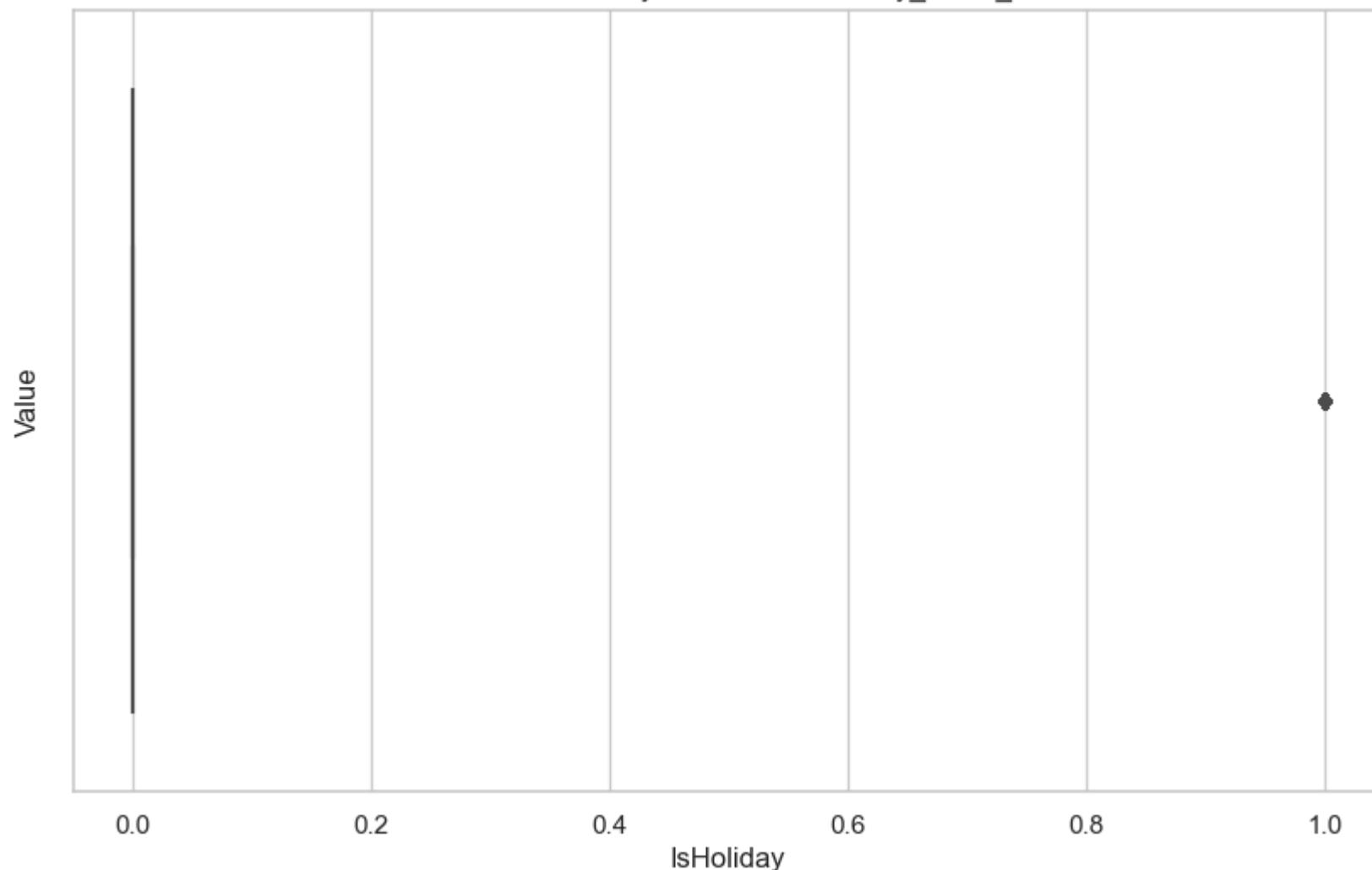


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_10w

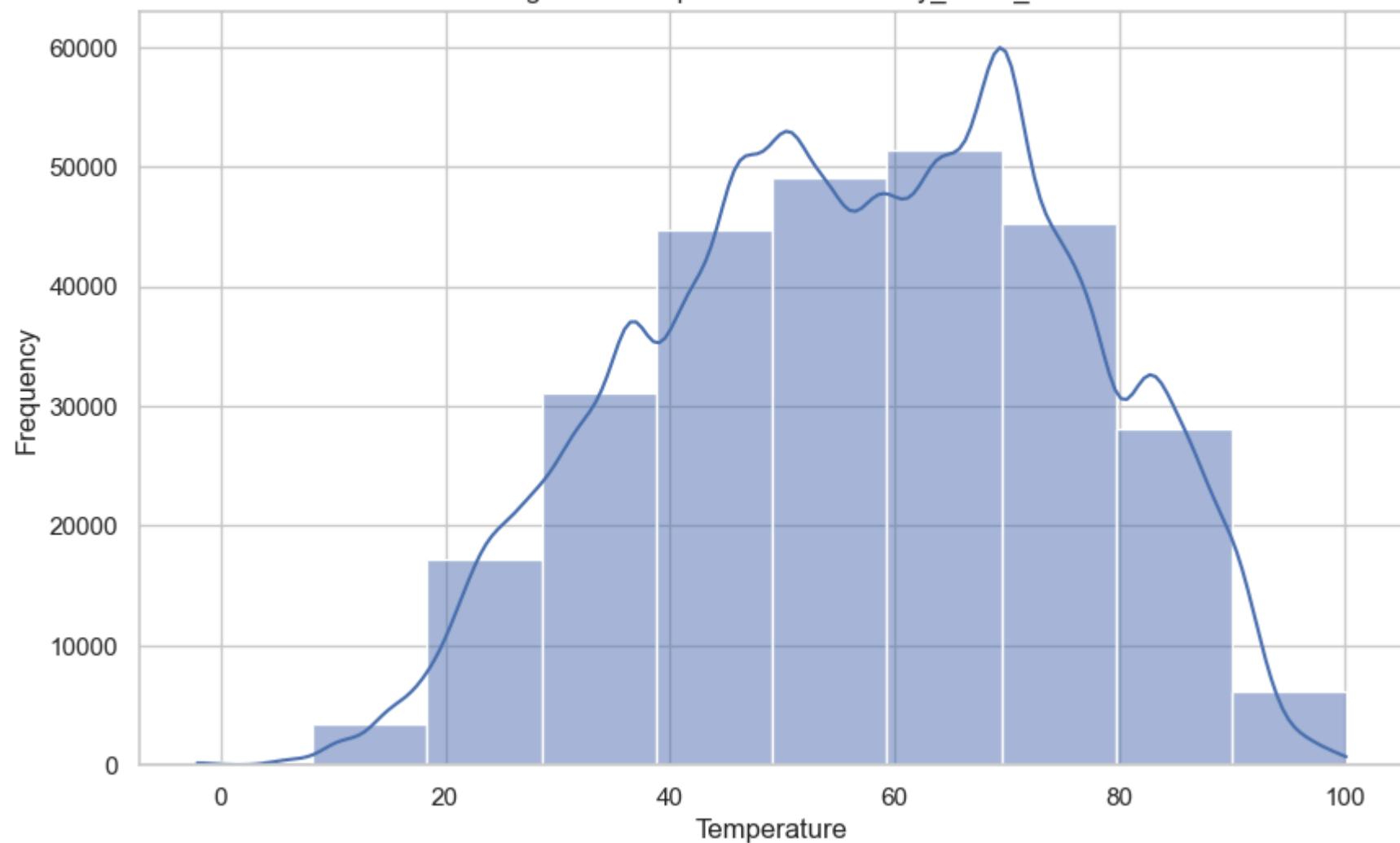


Box Plot of IsHoliday in Data with Weekly_Sales_10w

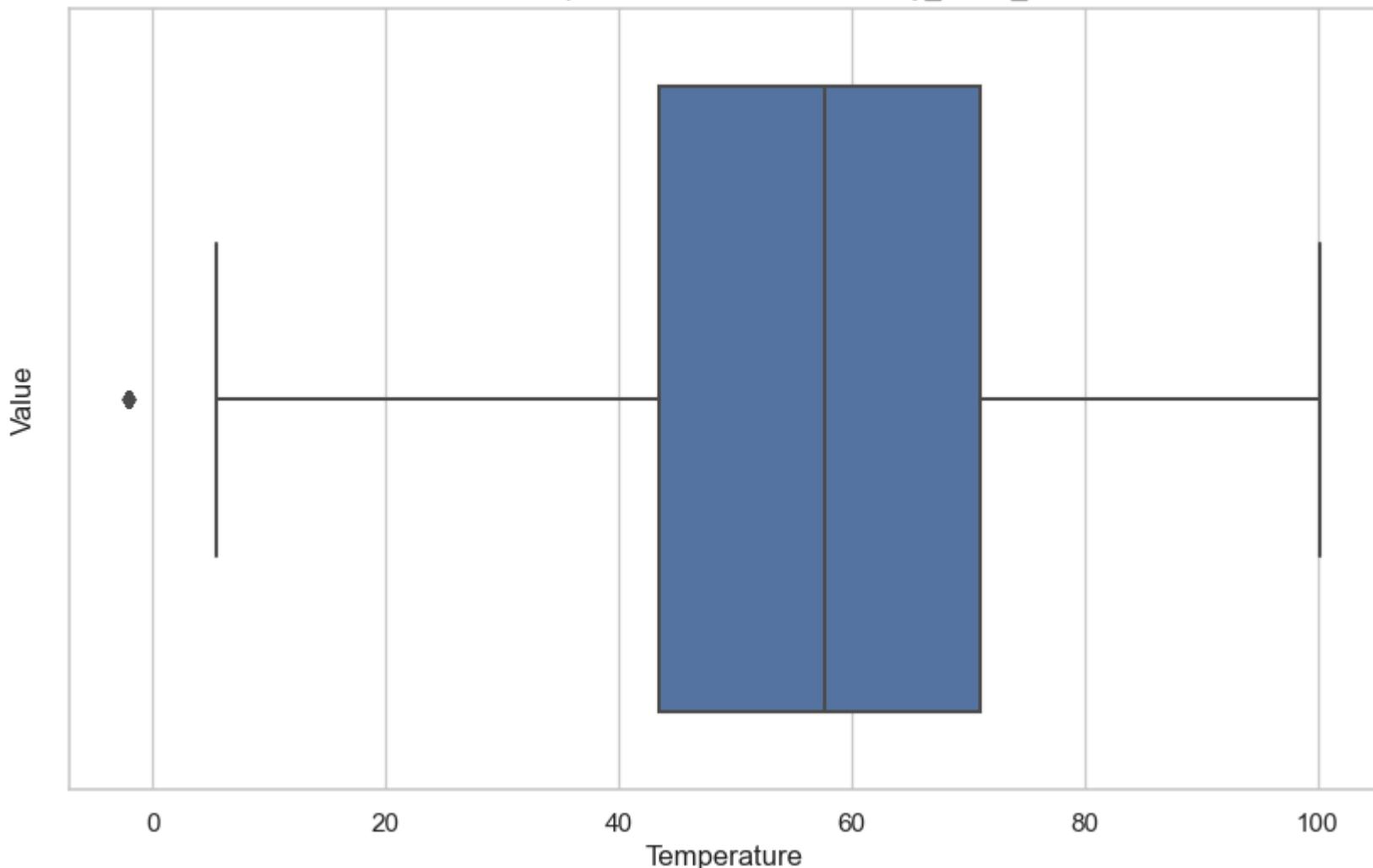


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_10w

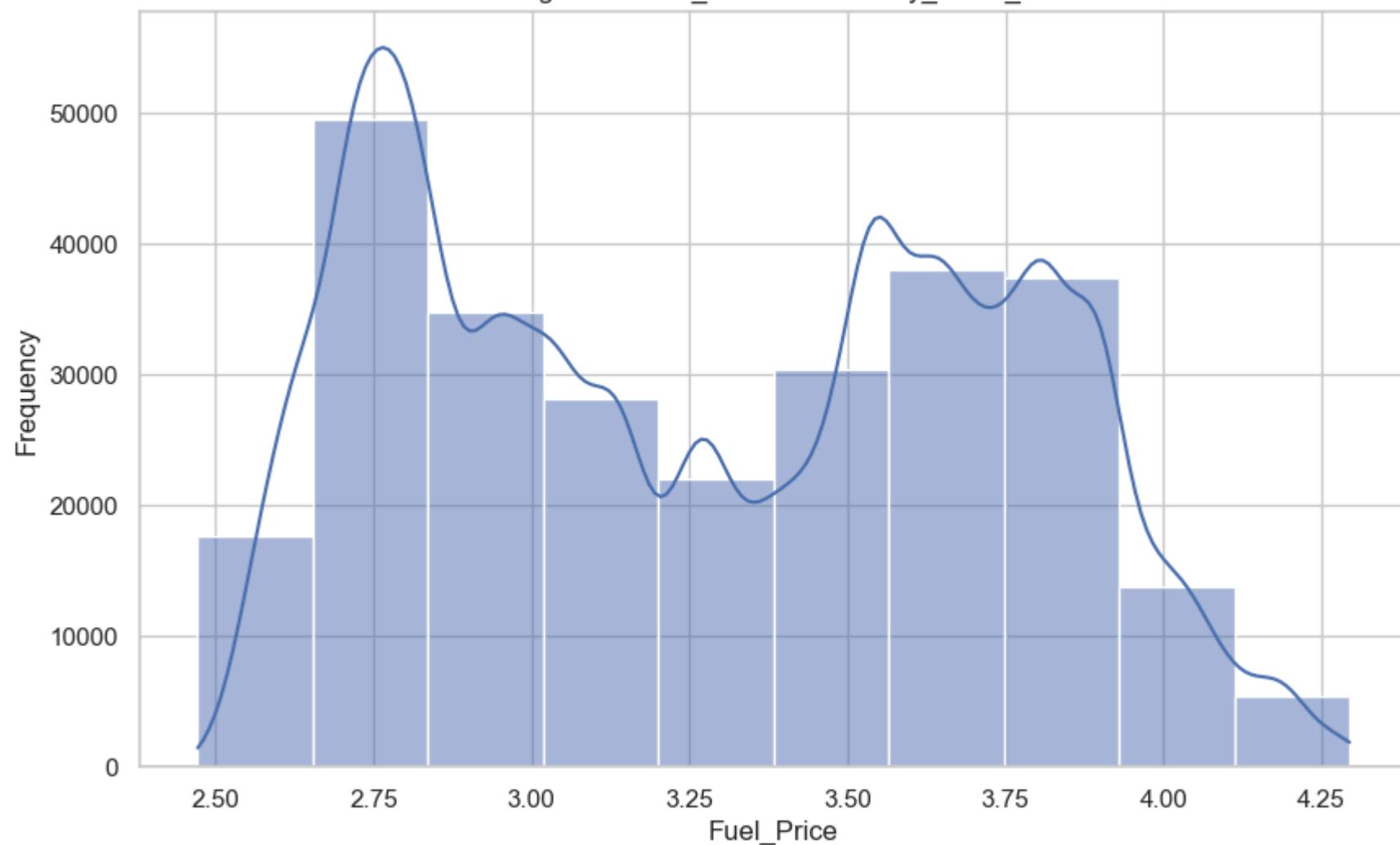


Box Plot of Temperature in Data with Weekly_Sales_10w

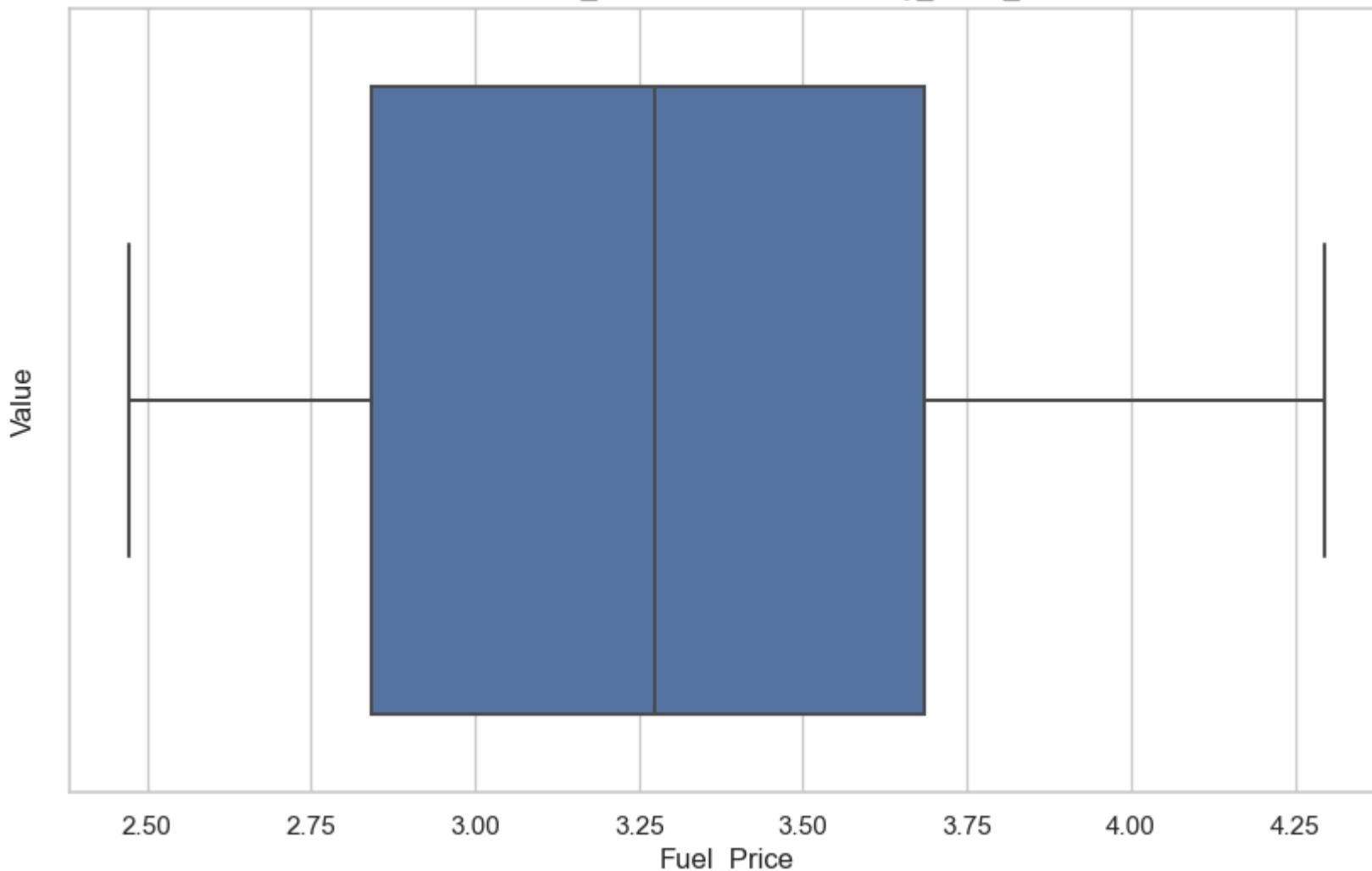


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Fuel_Price with Weekly_Sales_10w

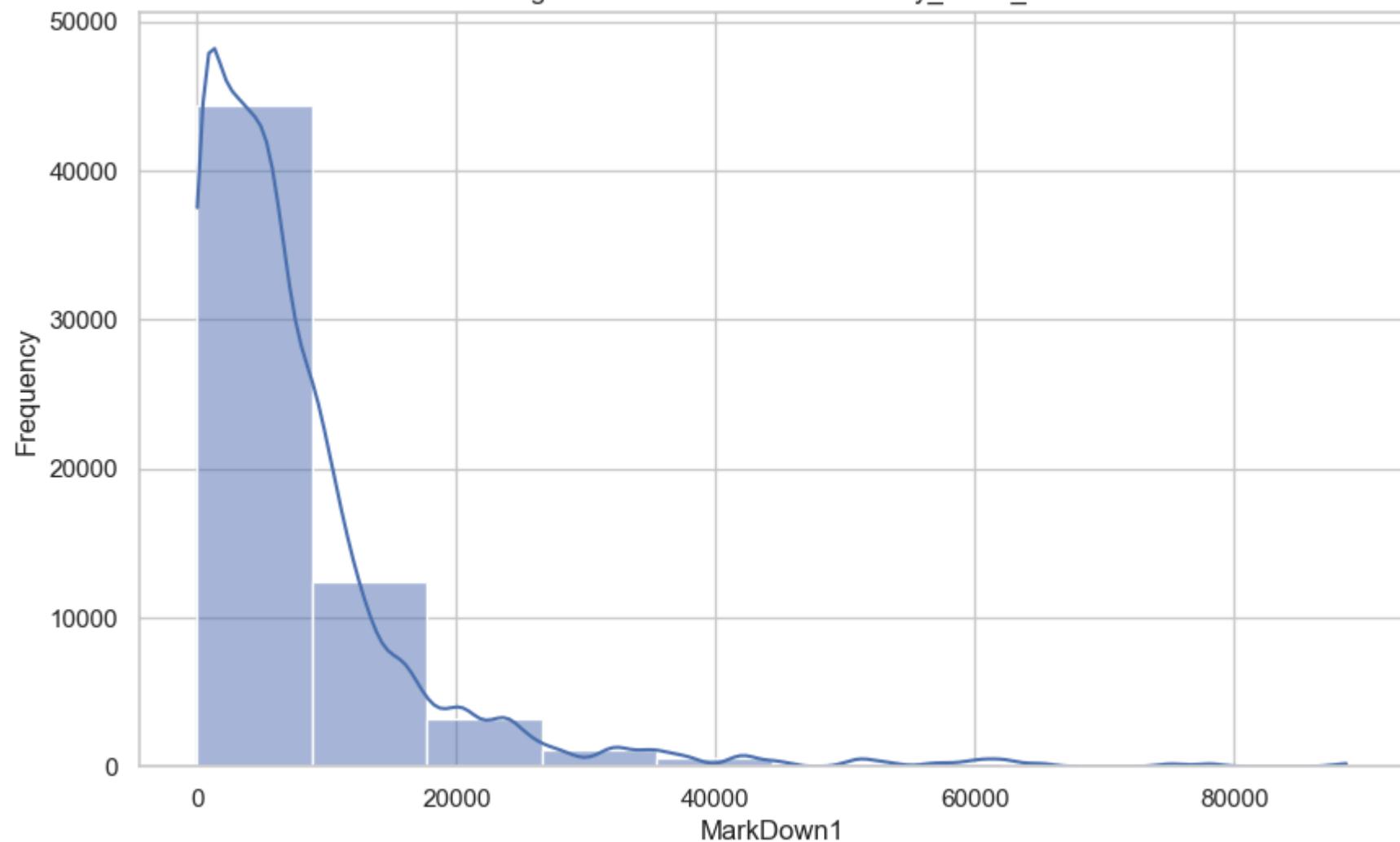


Box Plot of Fuel_Price in Data with Weekly_Sales_10w

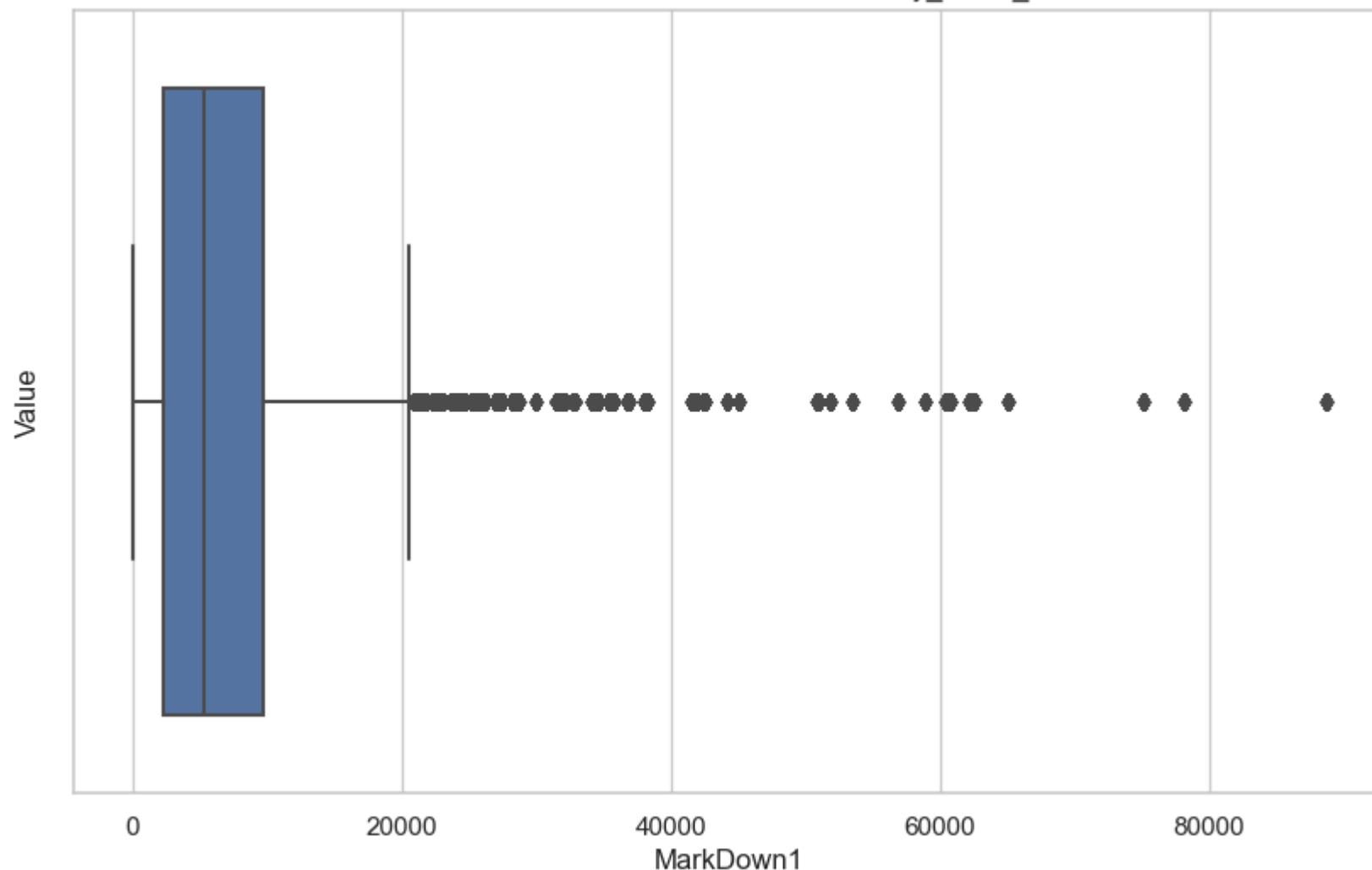


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown1 with Weekly_Sales_10w

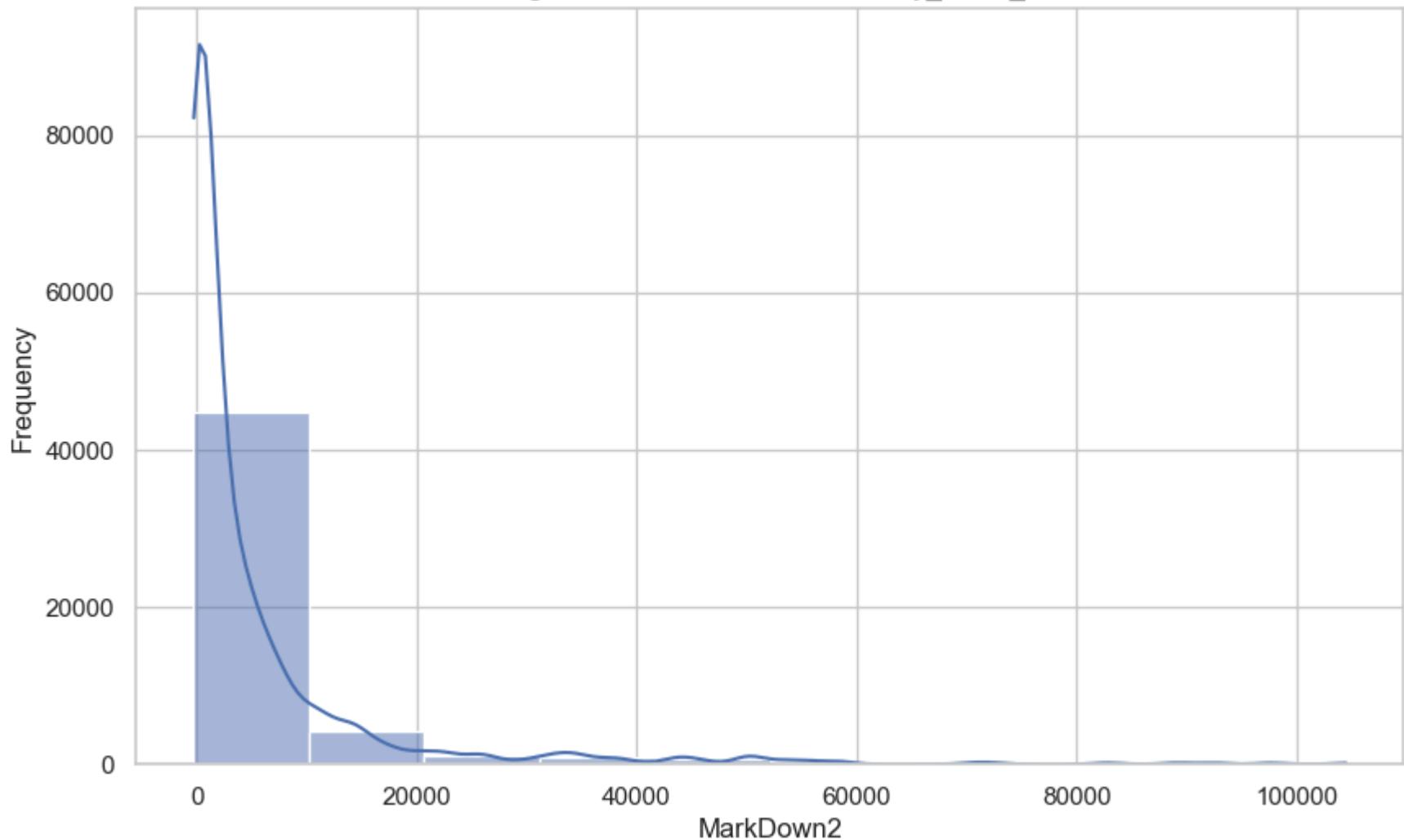


Box Plot of MarkDown1 in Data with Weekly_Sales_10w

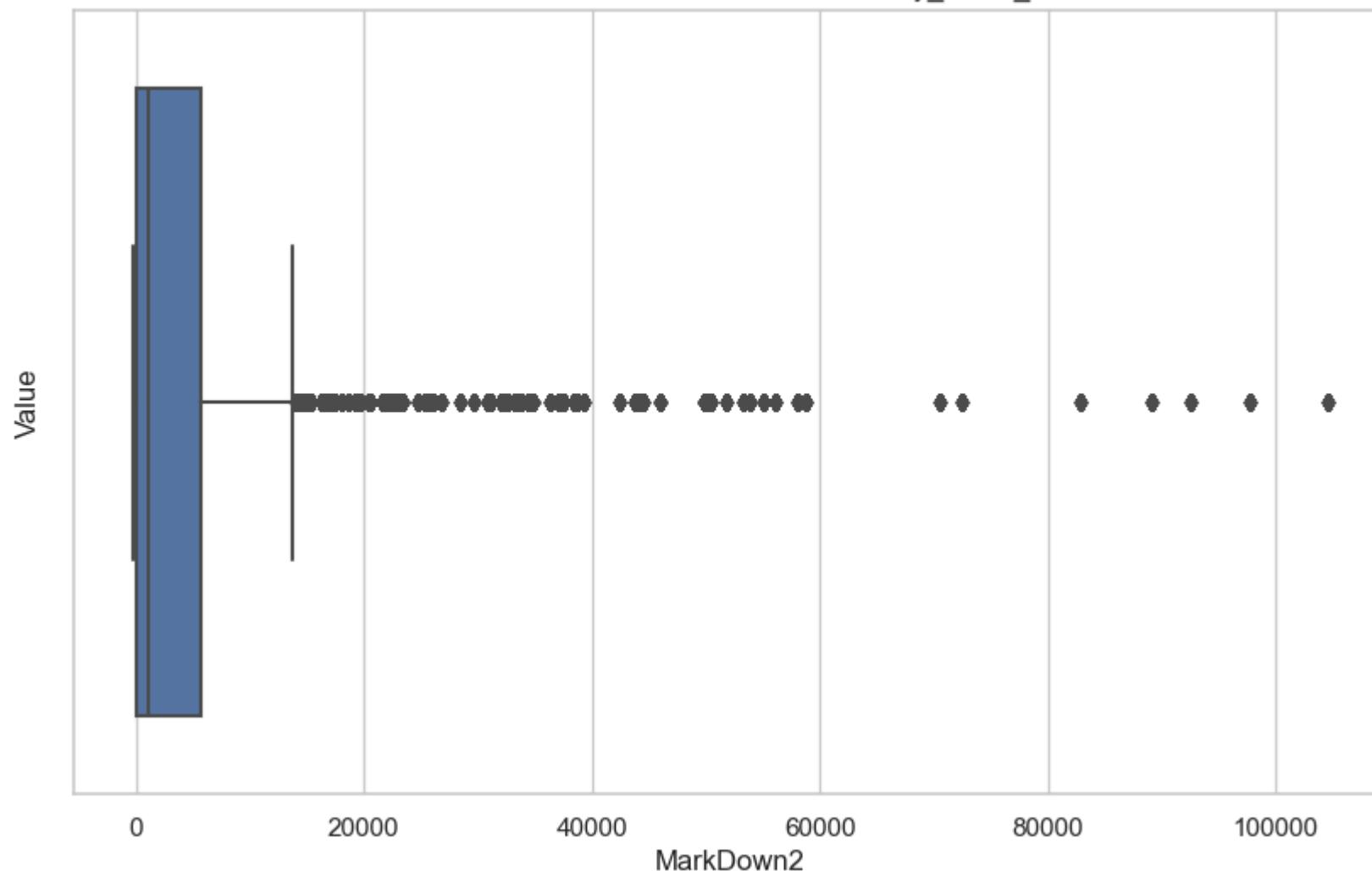


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_10w

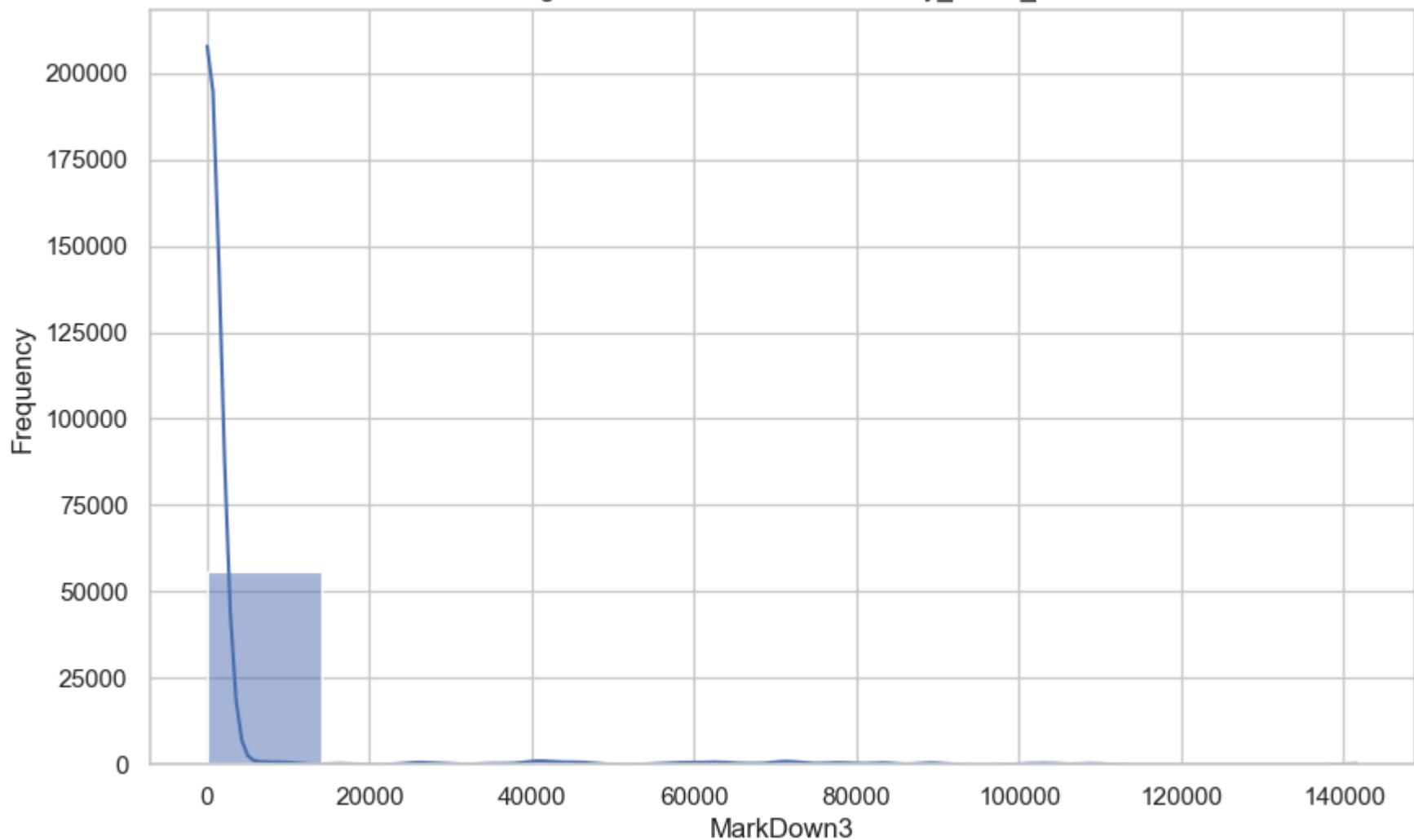


Box Plot of MarkDown2 in Data with Weekly_Sales_10w

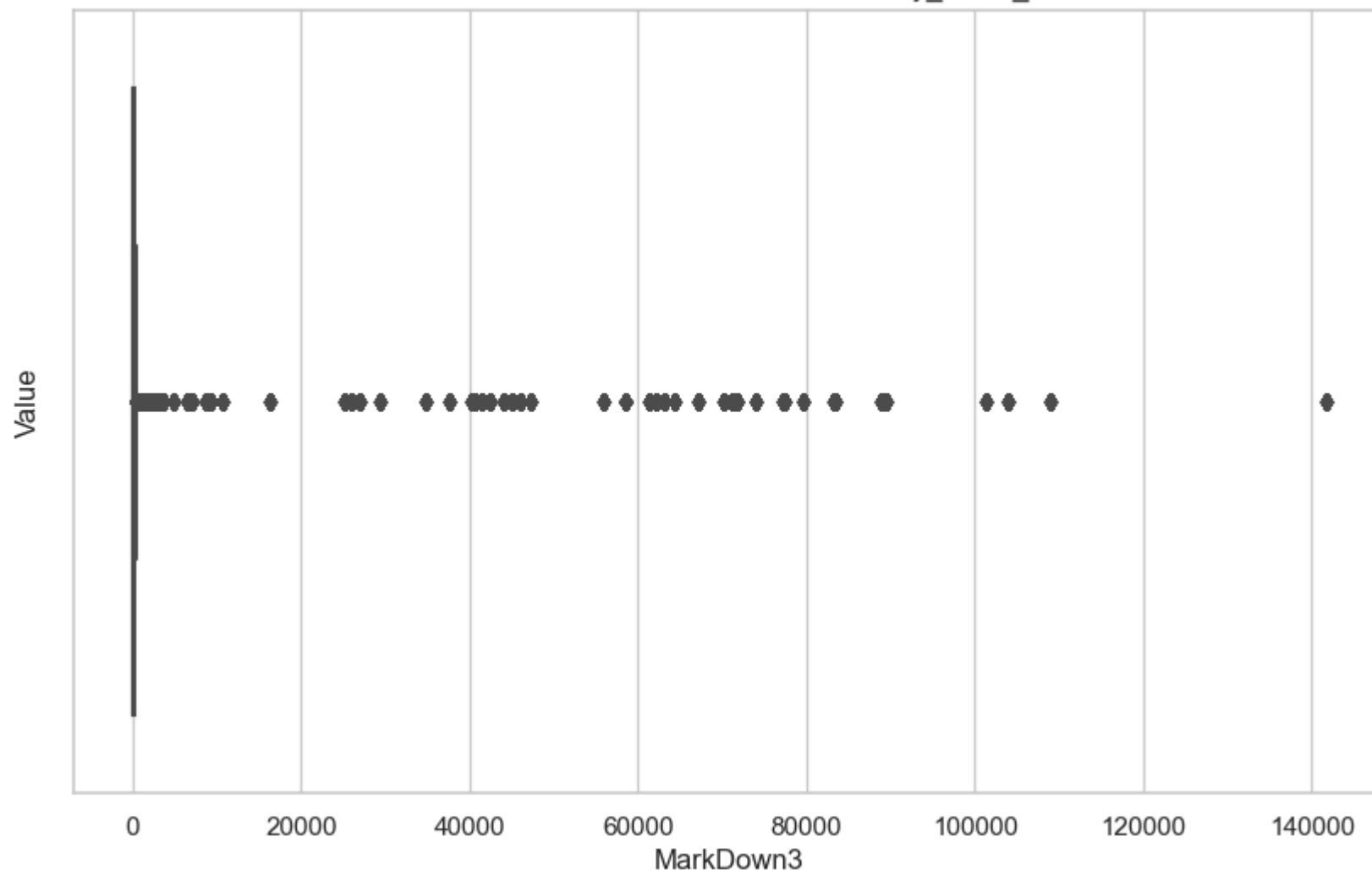


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_10w

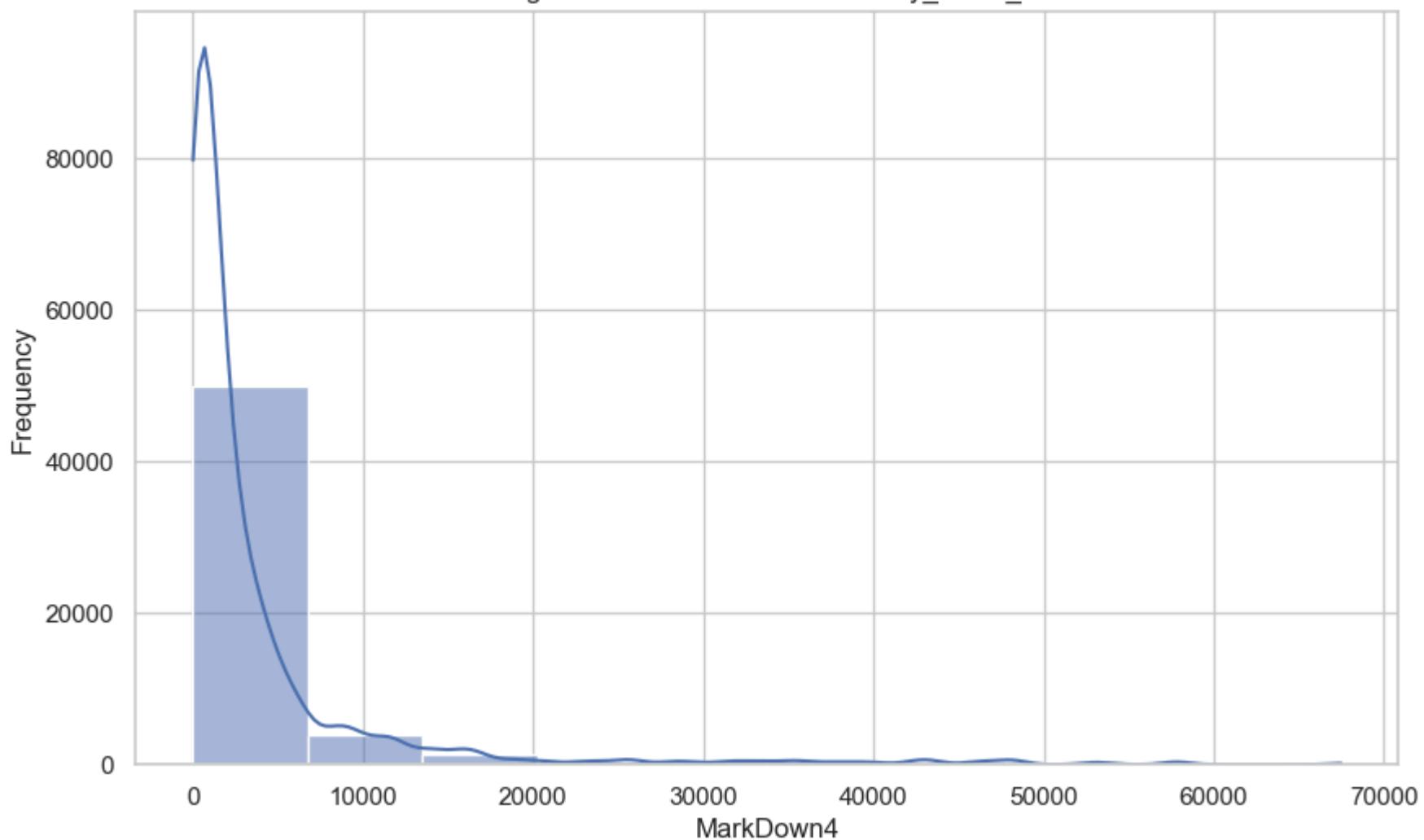


Box Plot of MarkDown3 in Data with Weekly_Sales_10w

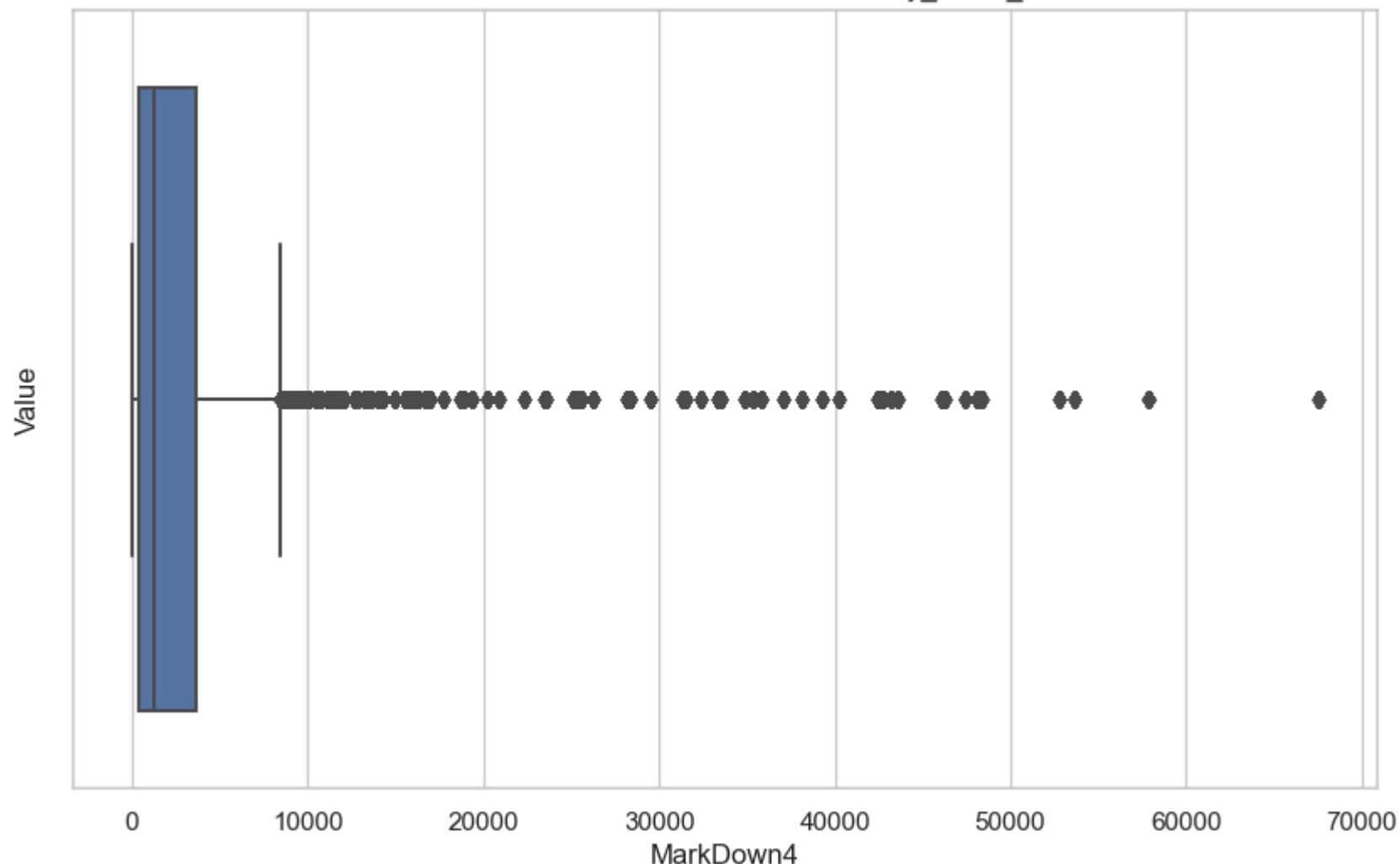


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_10w

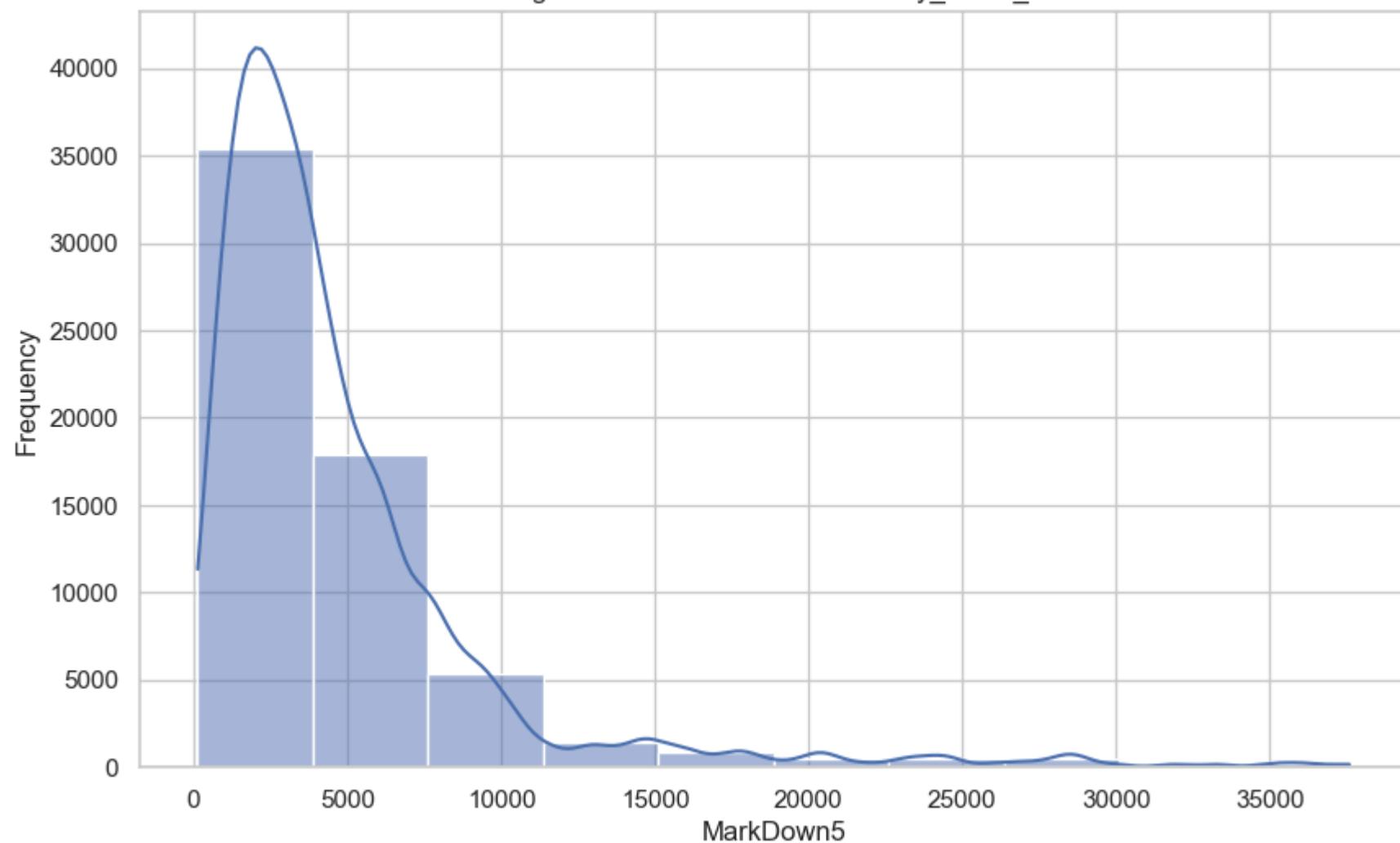


Box Plot of MarkDown4 in Data with Weekly_Sales_10w

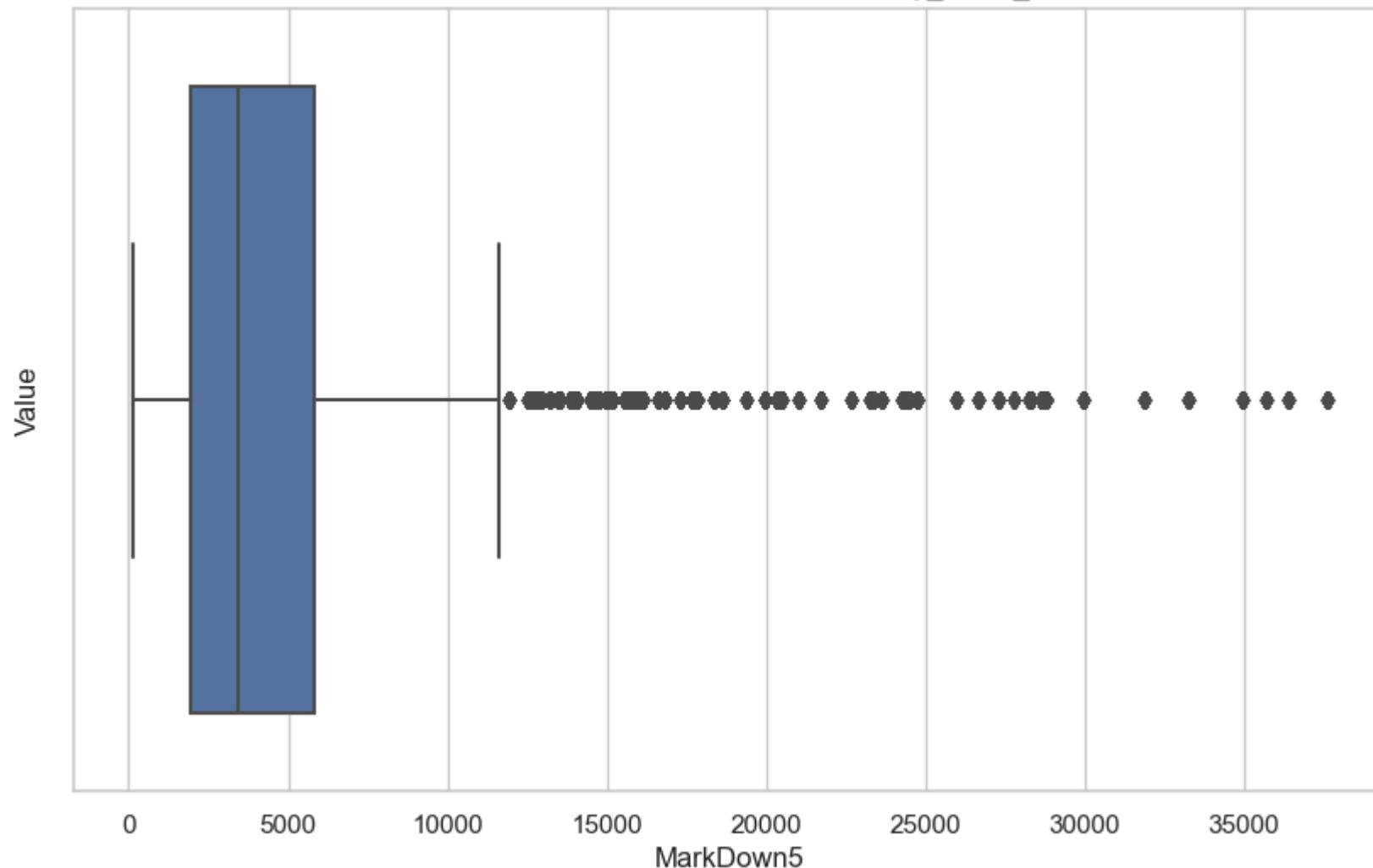


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_10w

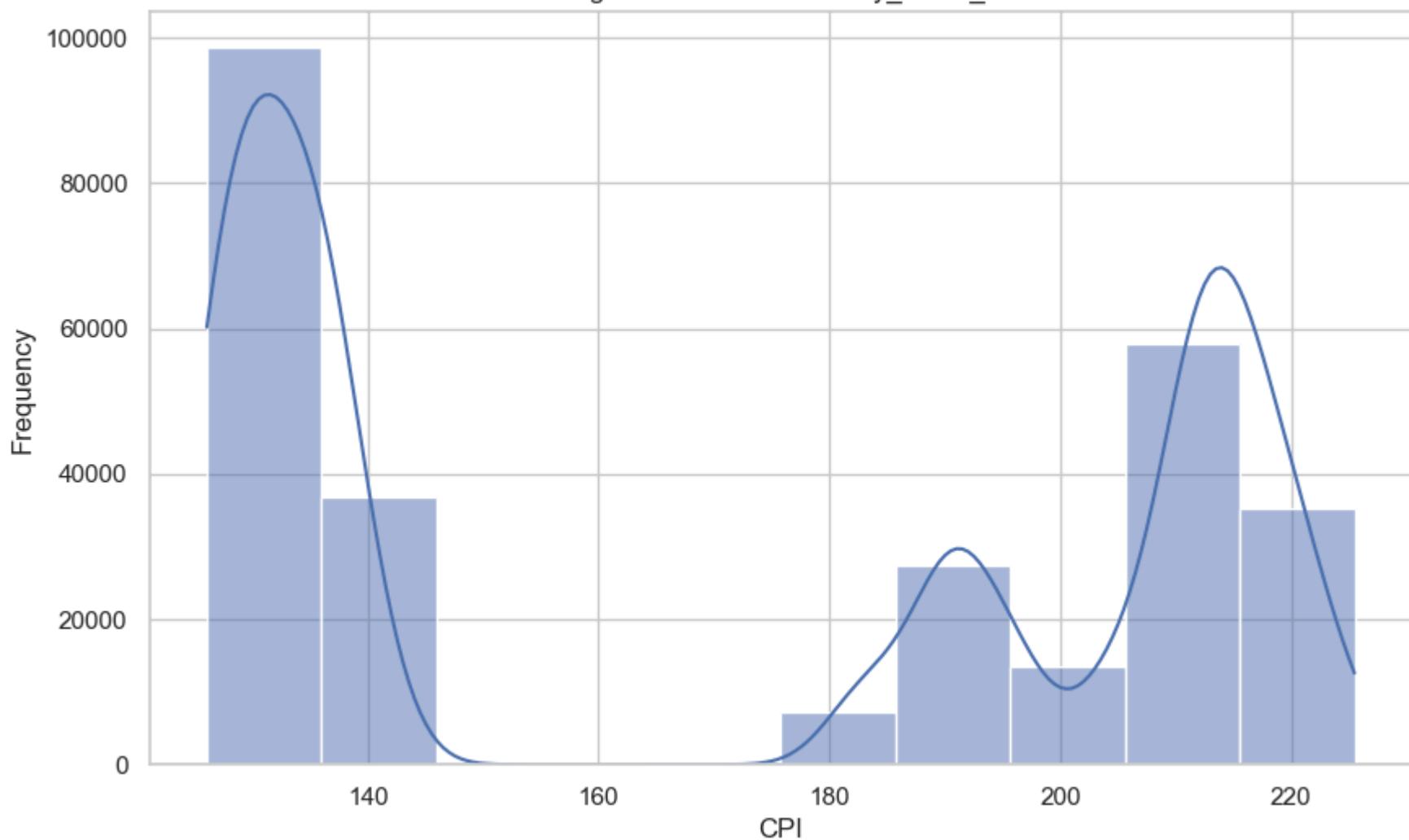


Box Plot of MarkDown5 in Data with Weekly_Sales_10w

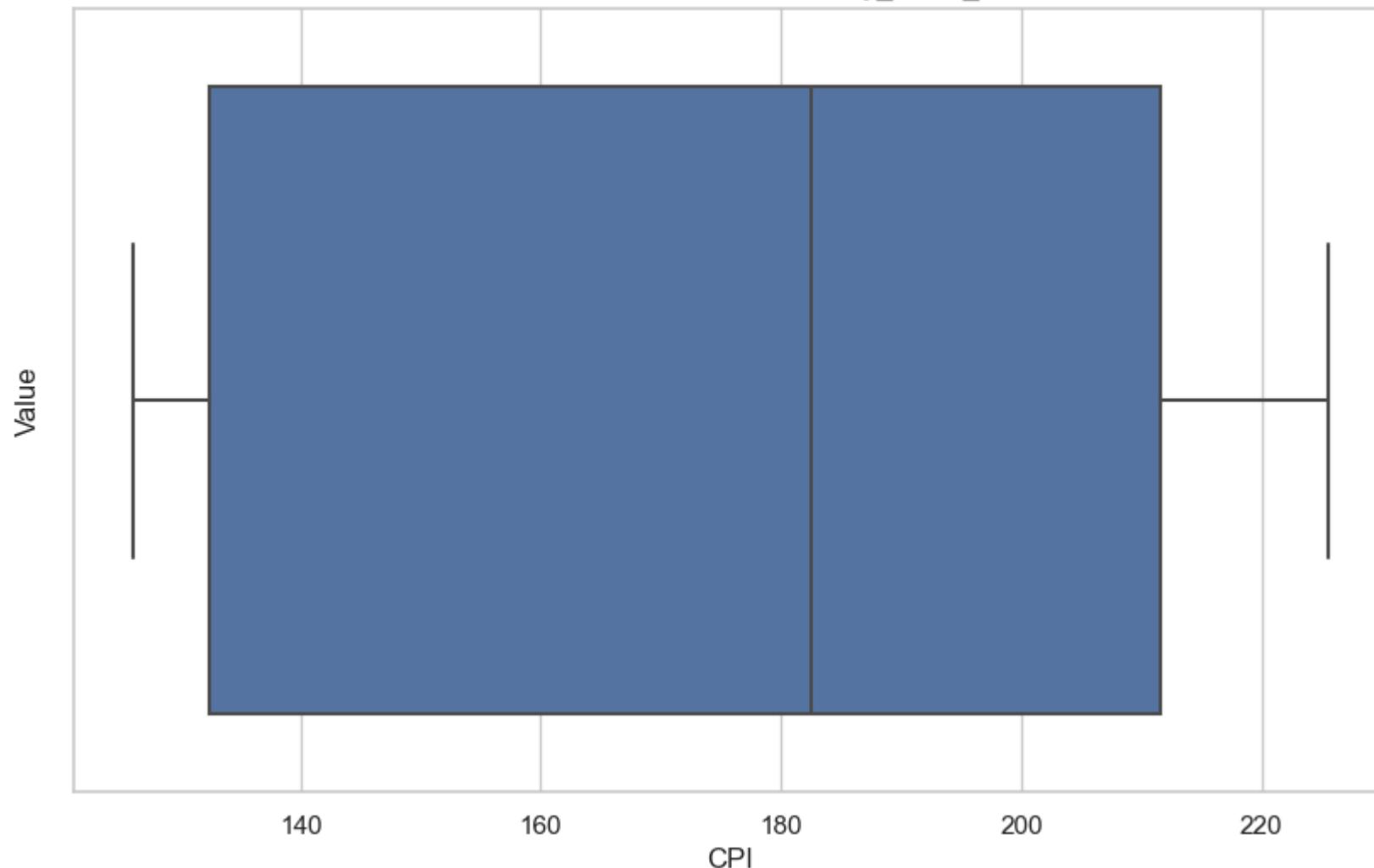


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_10w

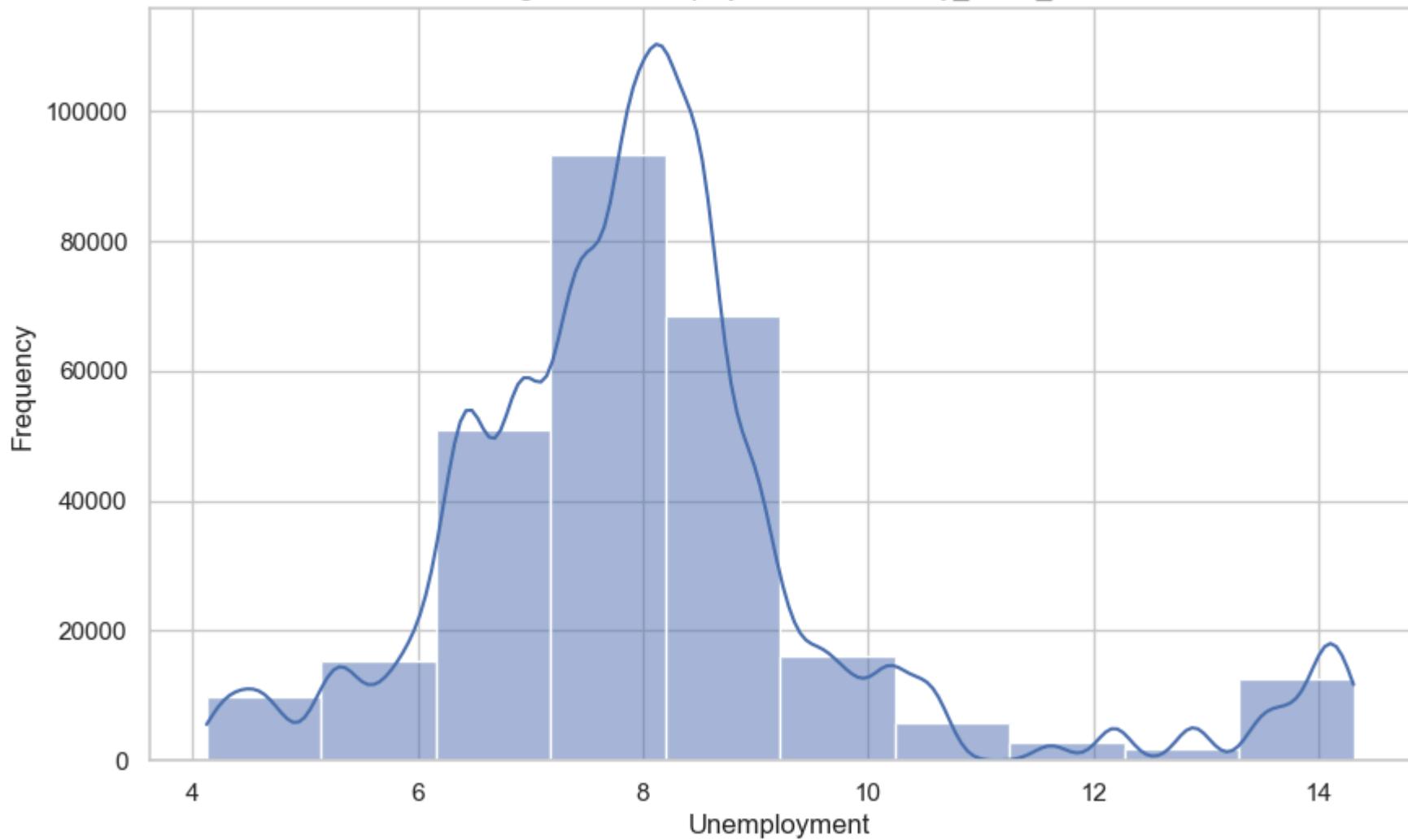


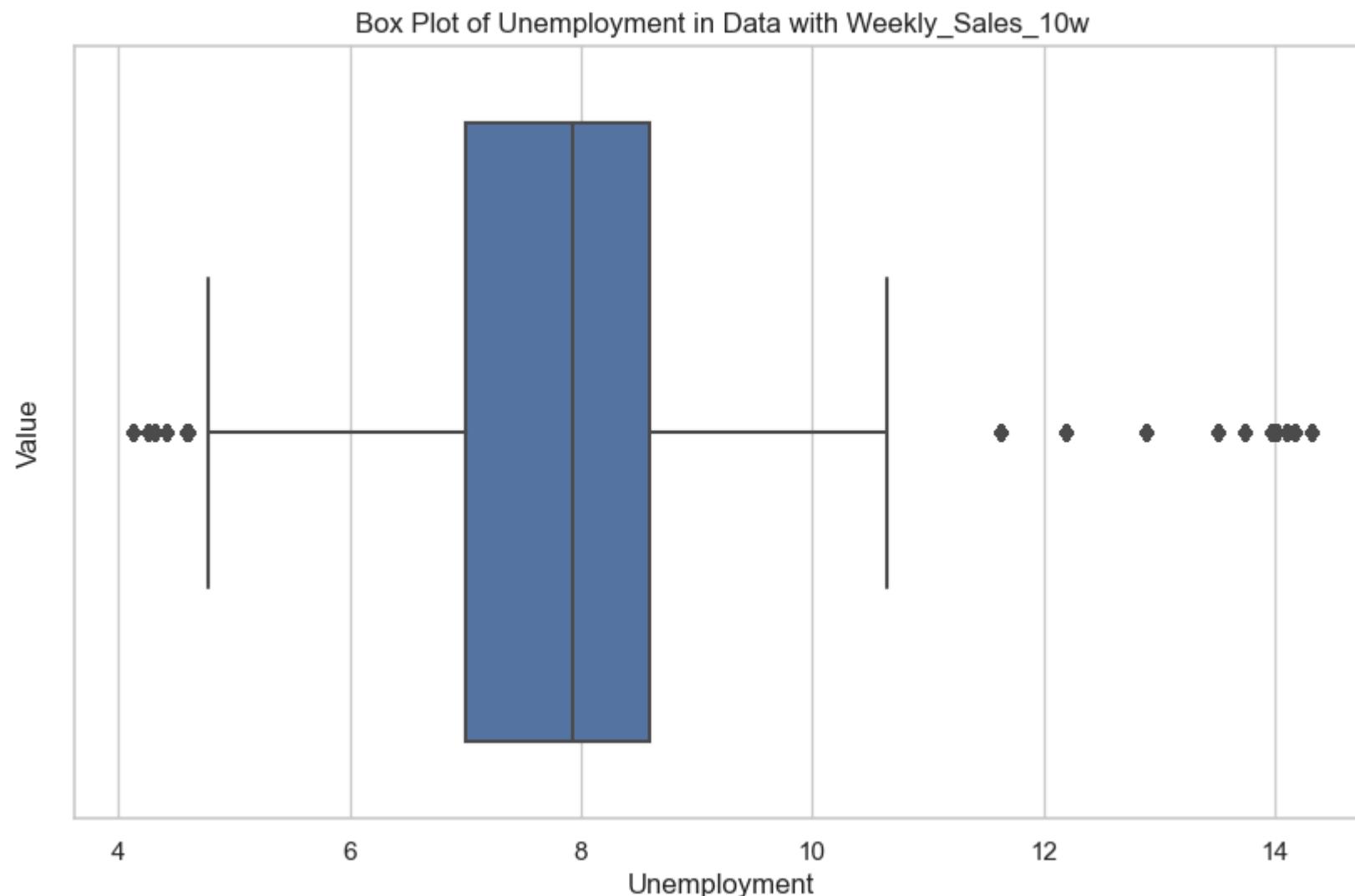
Box Plot of CPI in Data with Weekly_Sales_10w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

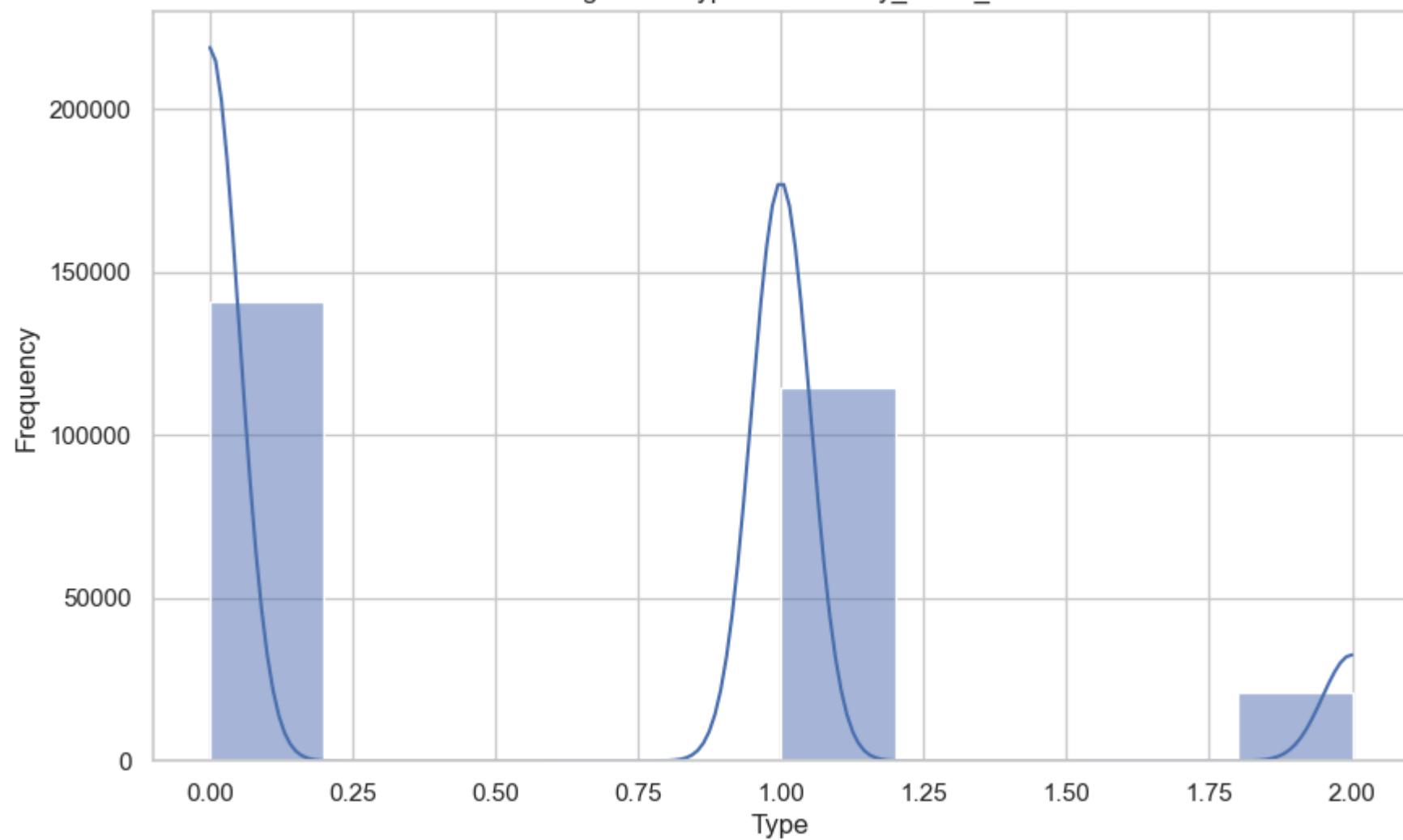
Histogram of Unemployment with Weekly_Sales_10w



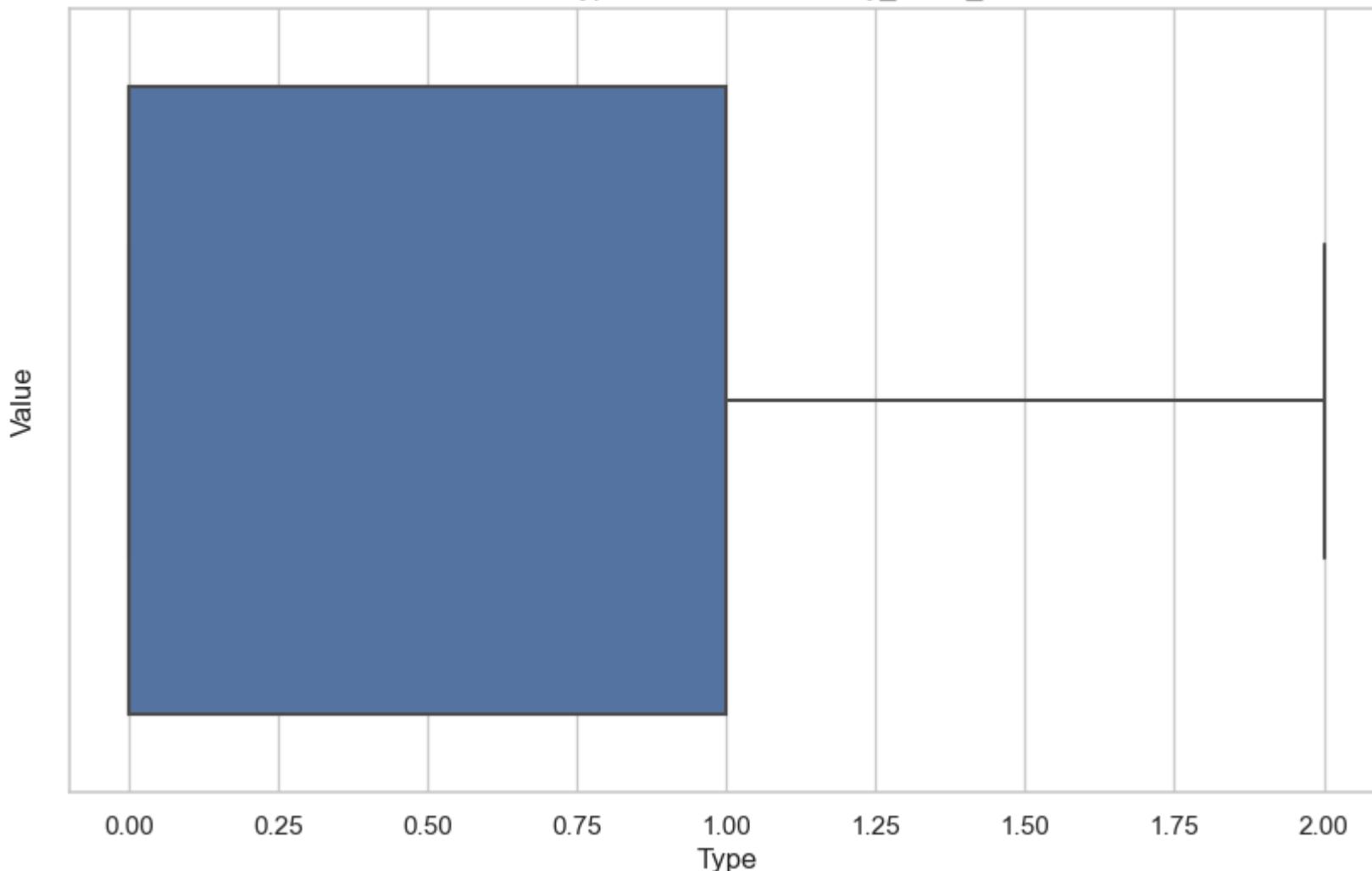


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

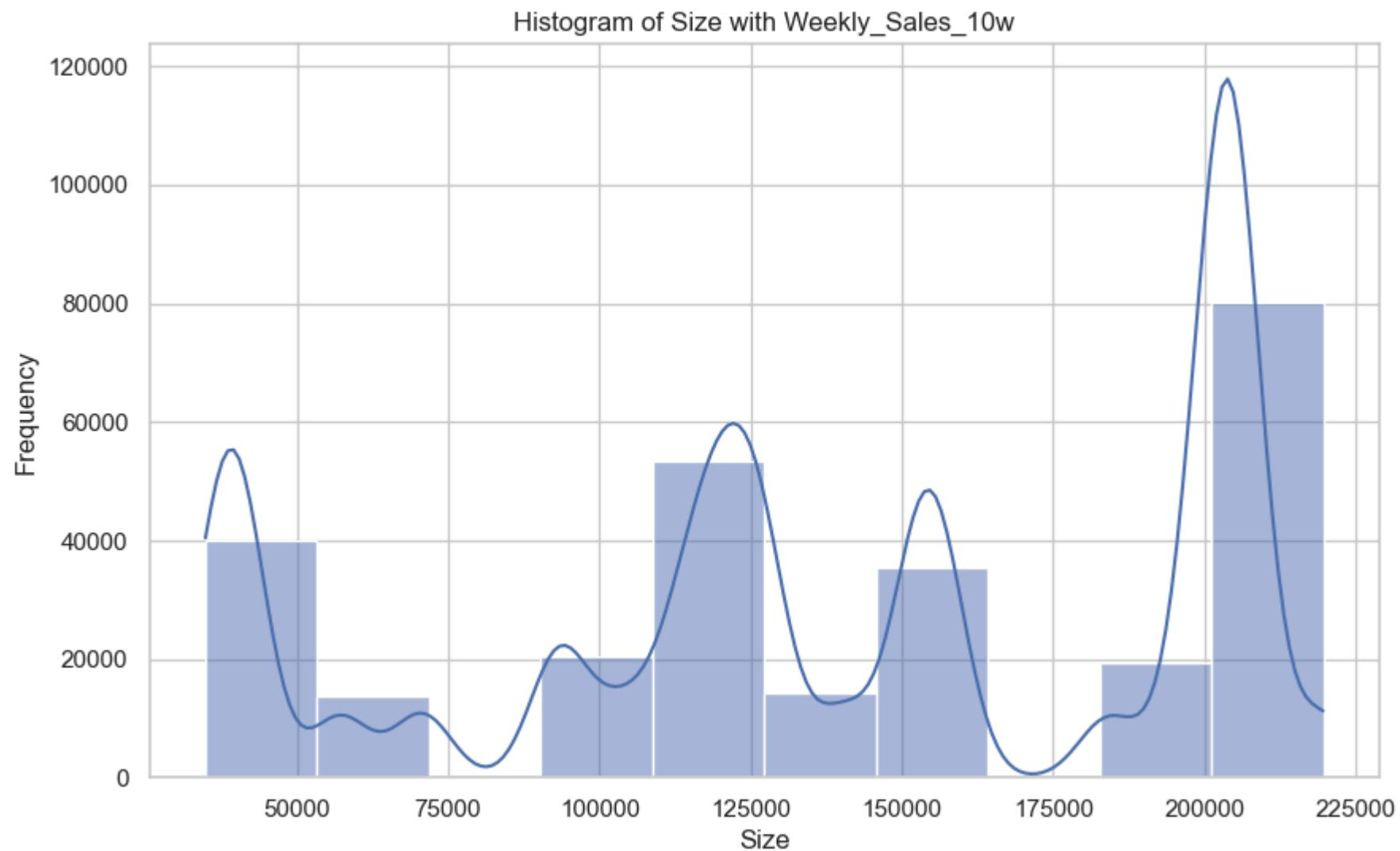
Histogram of Type with Weekly_Sales_10w



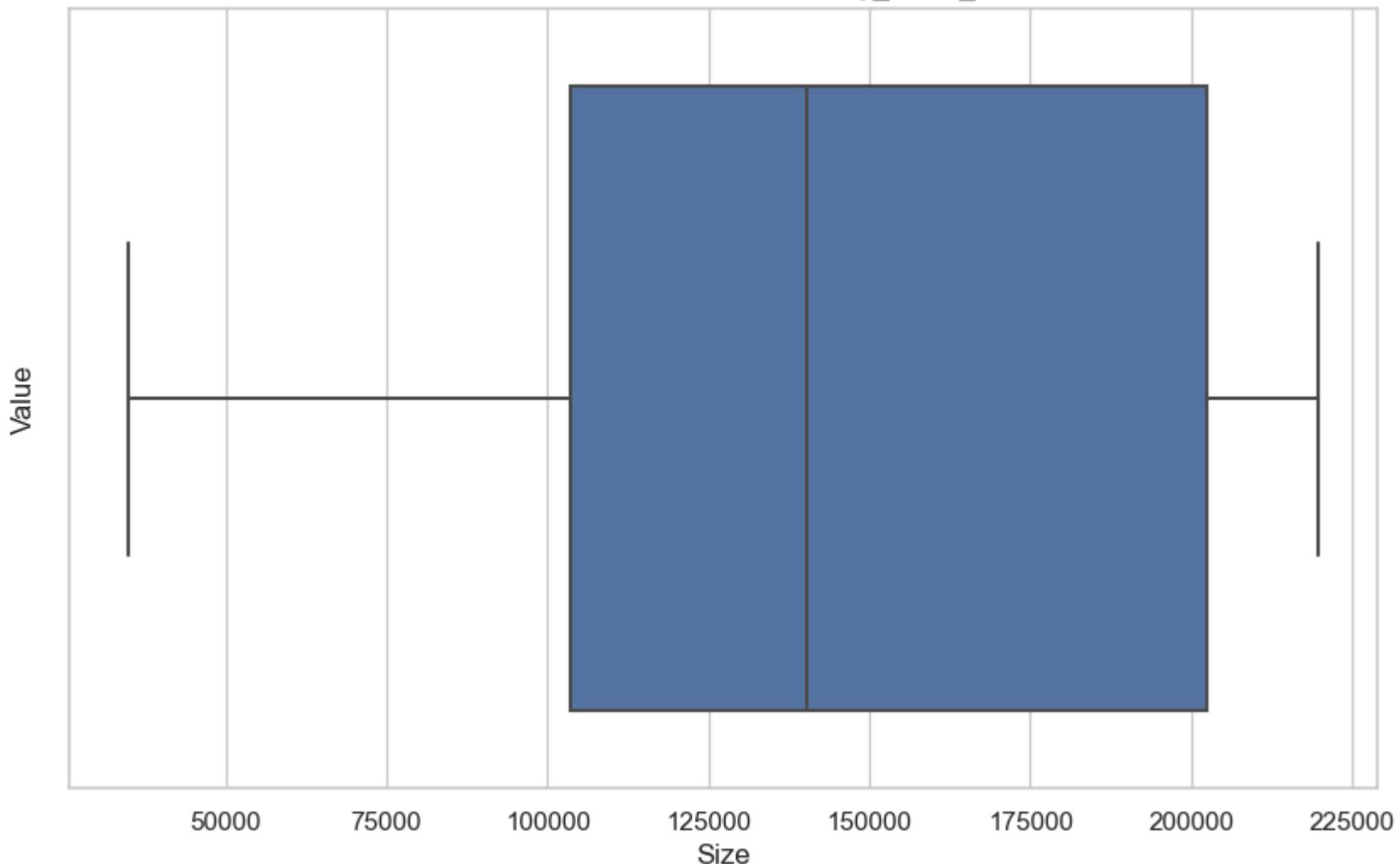
Box Plot of Type in Data with Weekly_Sales_10w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

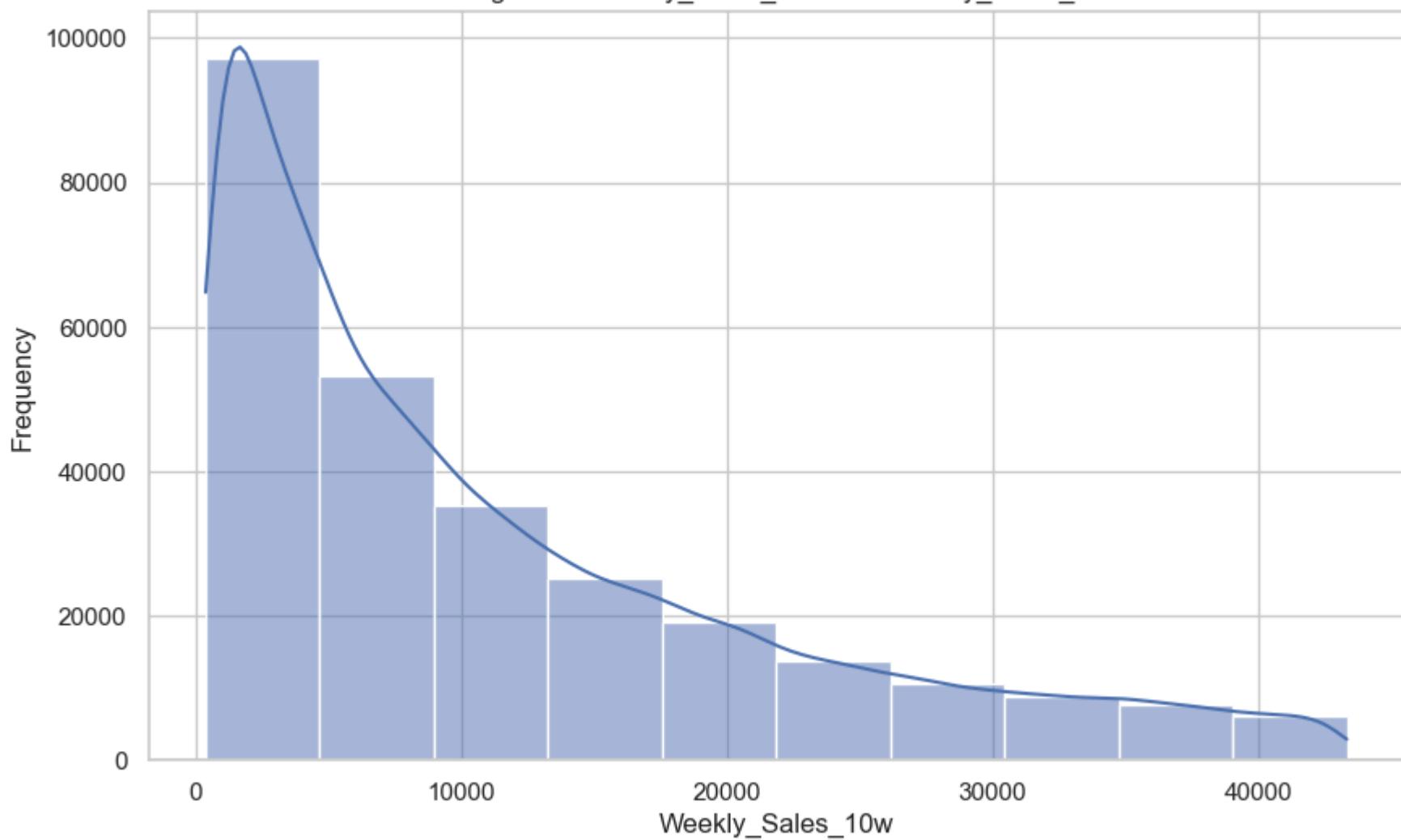


Box Plot of Size in Data with Weekly_Sales_10w

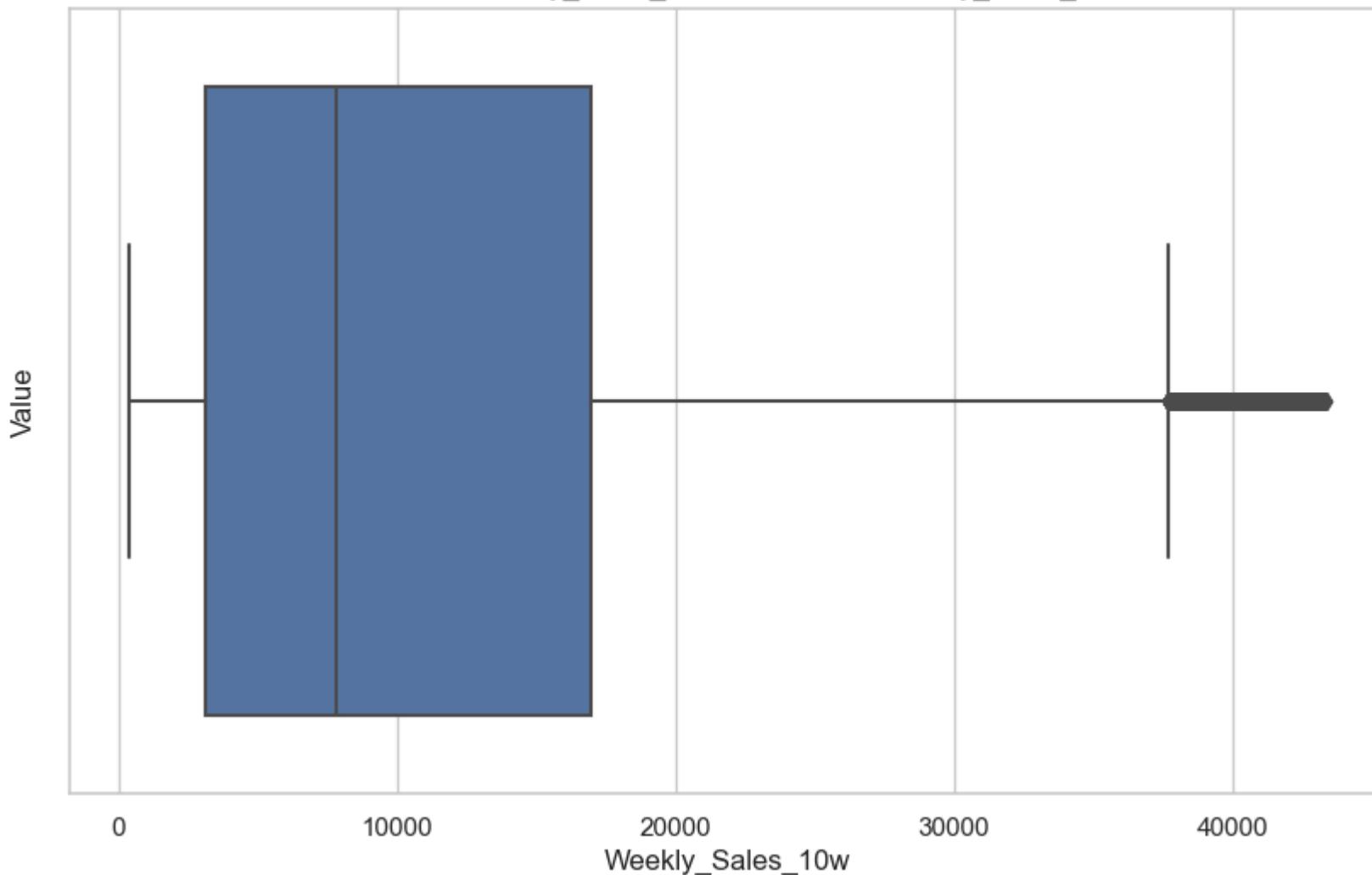


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_10w with Weekly_Sales_10w

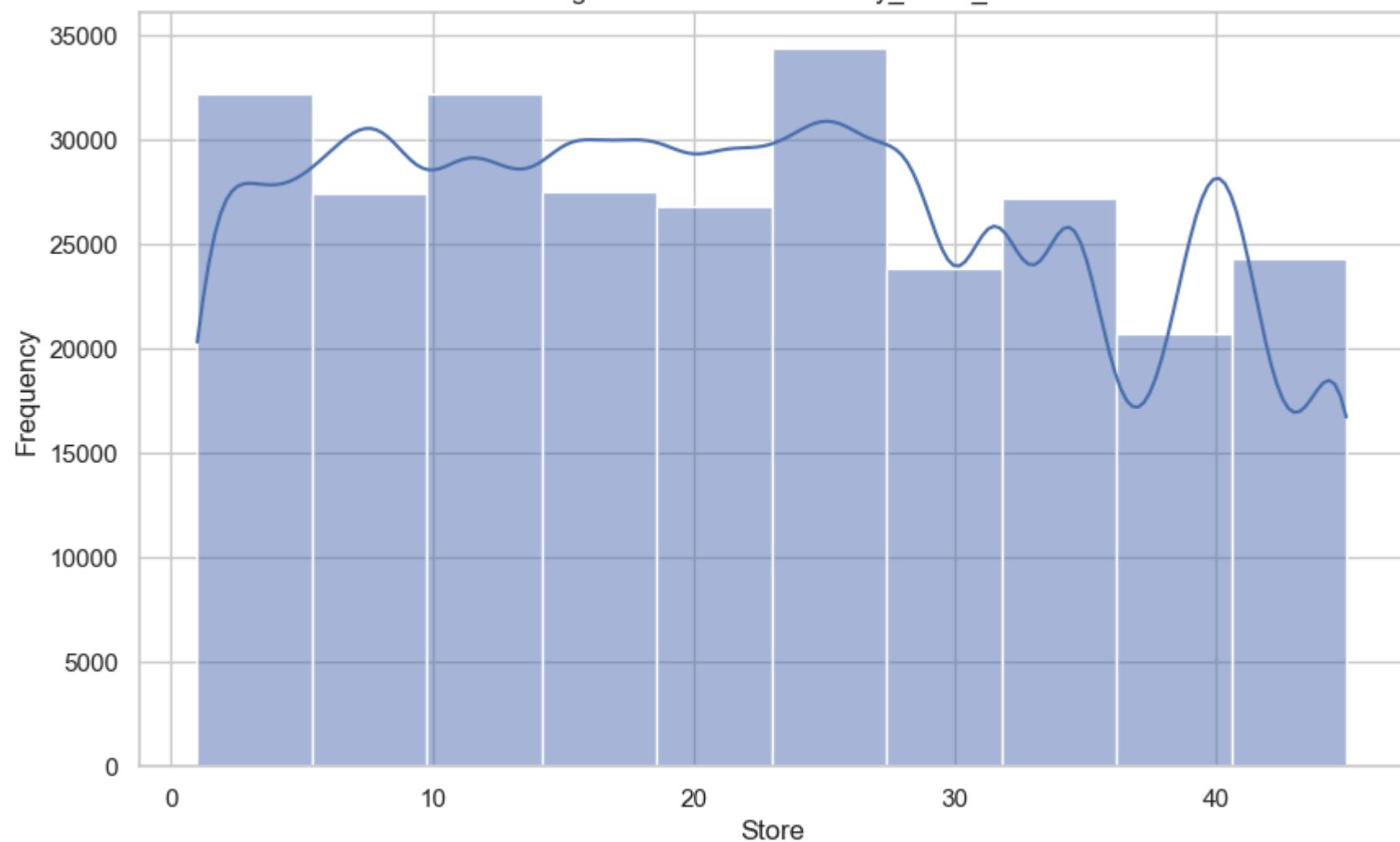


Box Plot of Weekly_Sales_10w in Data with Weekly_Sales_10w

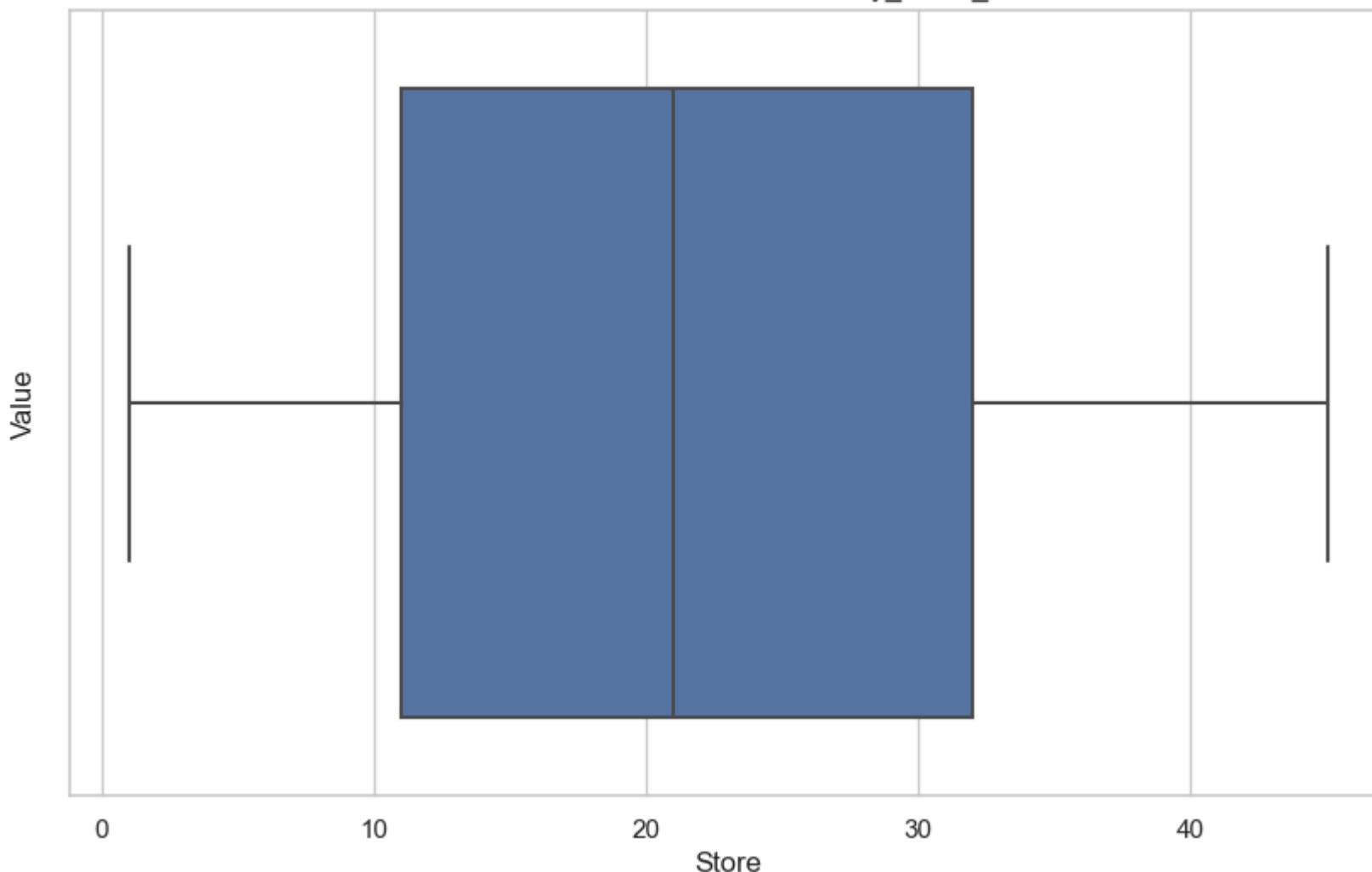


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_11w

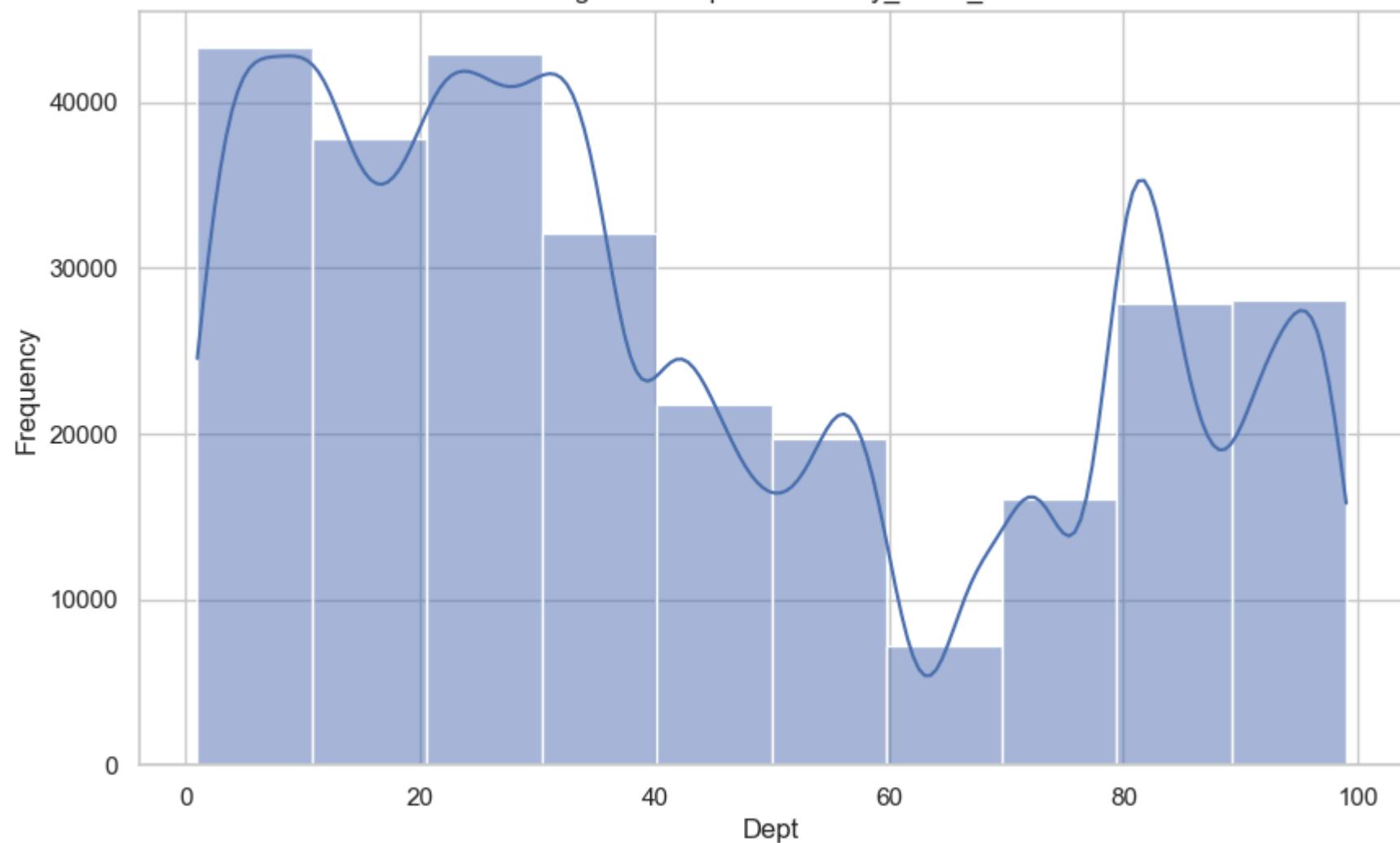


Box Plot of Store in Data with Weekly_Sales_11w

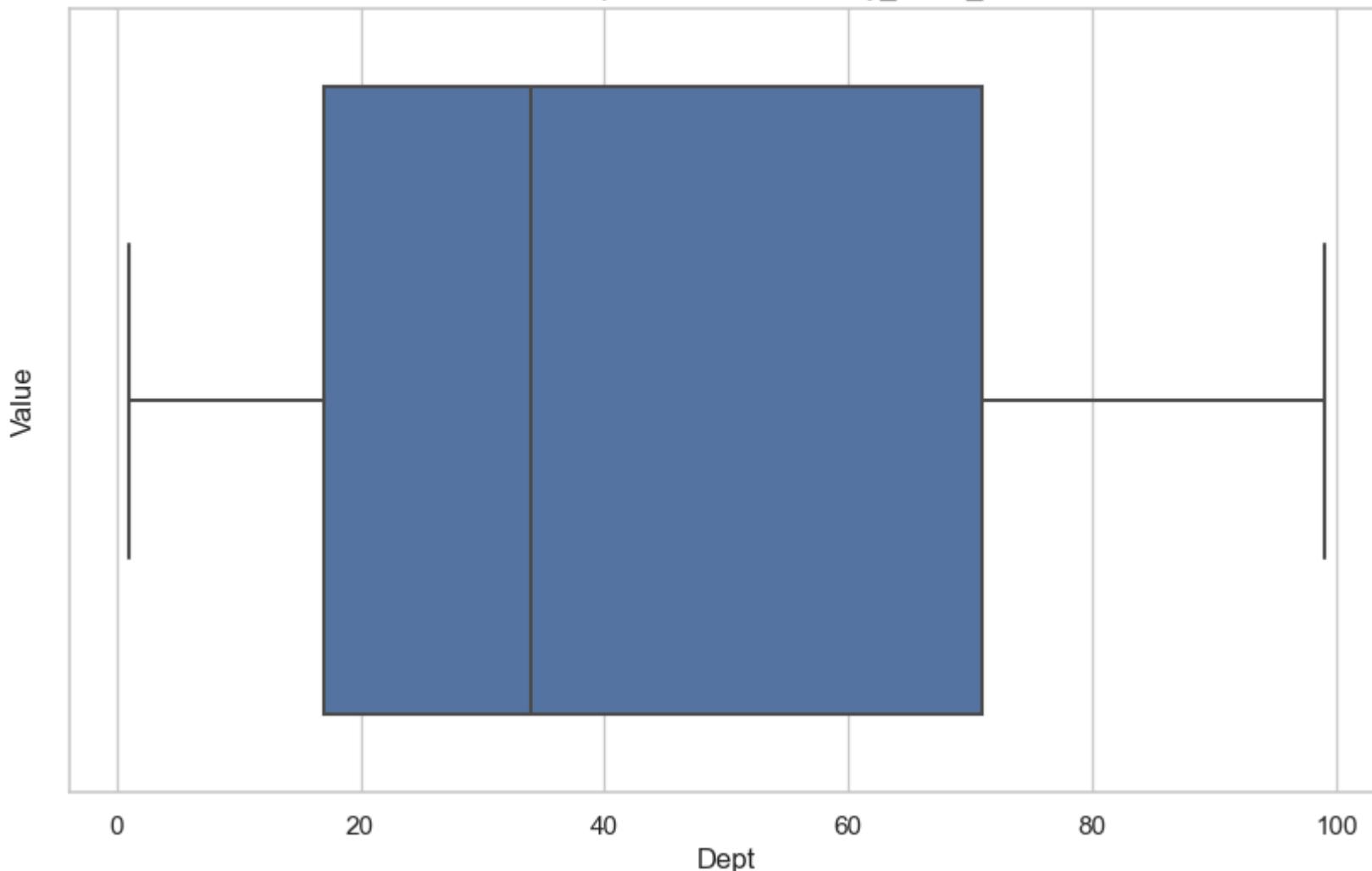


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

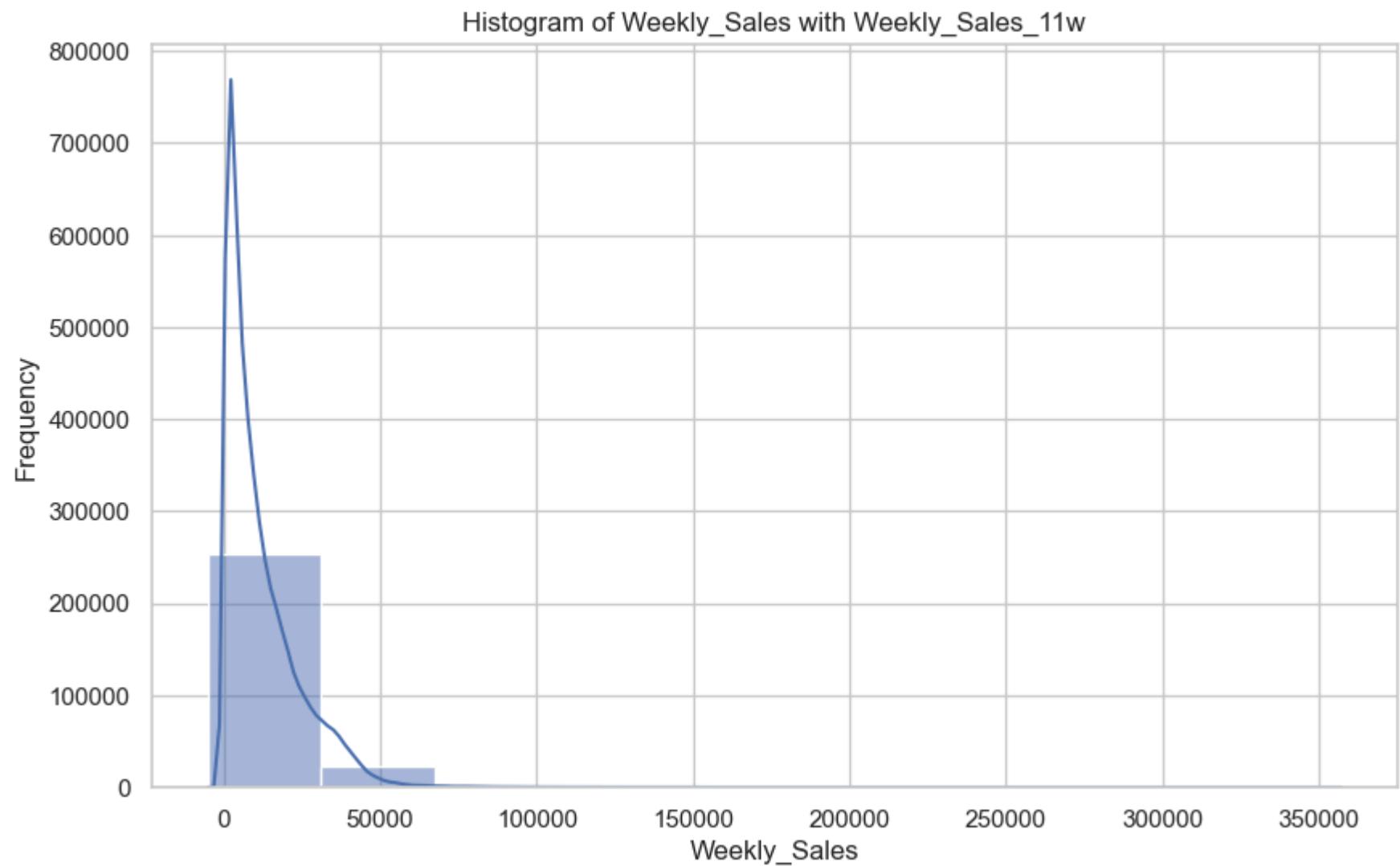
Histogram of Dept with Weekly_Sales_11w



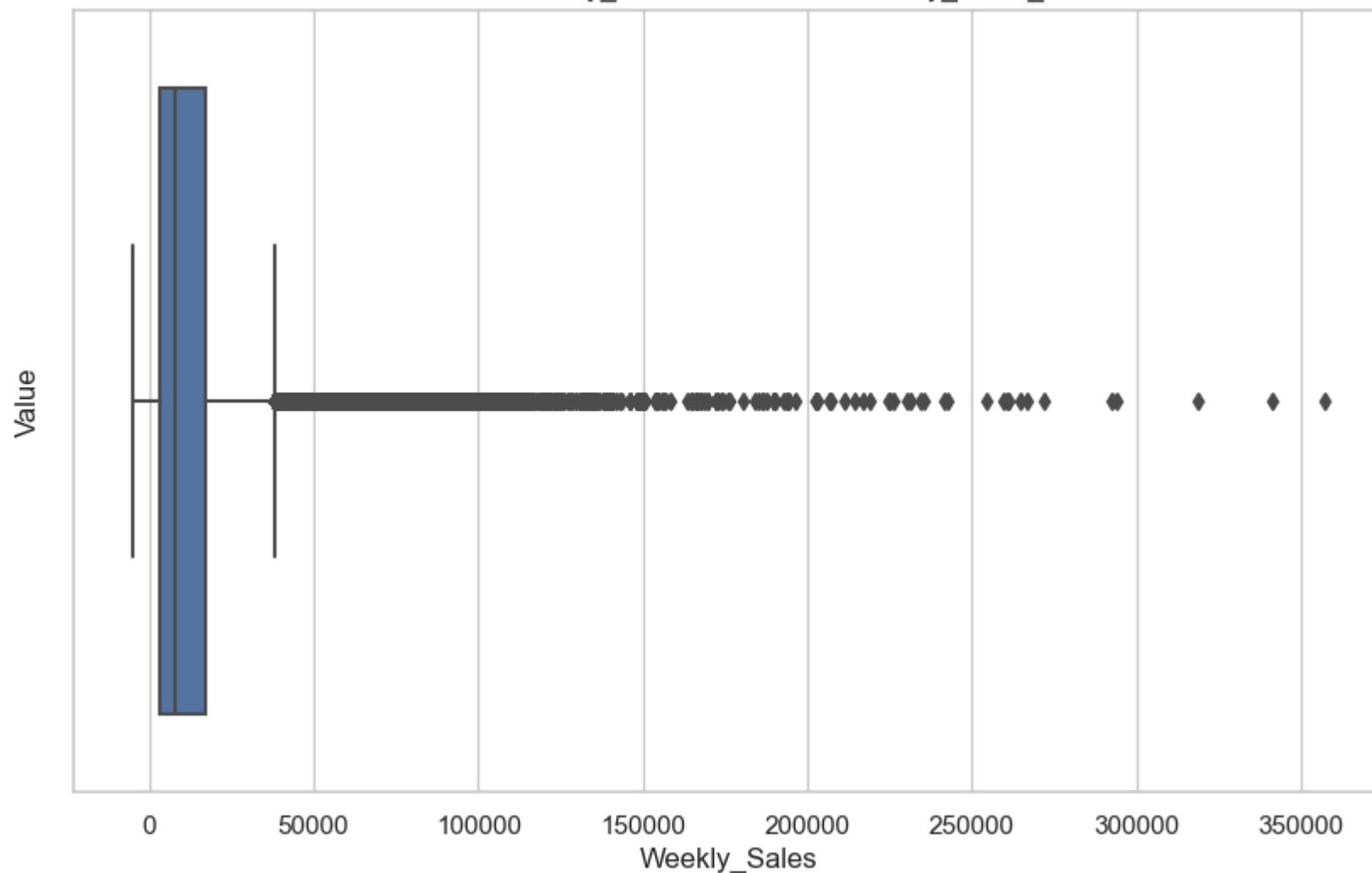
Box Plot of Dept in Data with Weekly_Sales_11w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

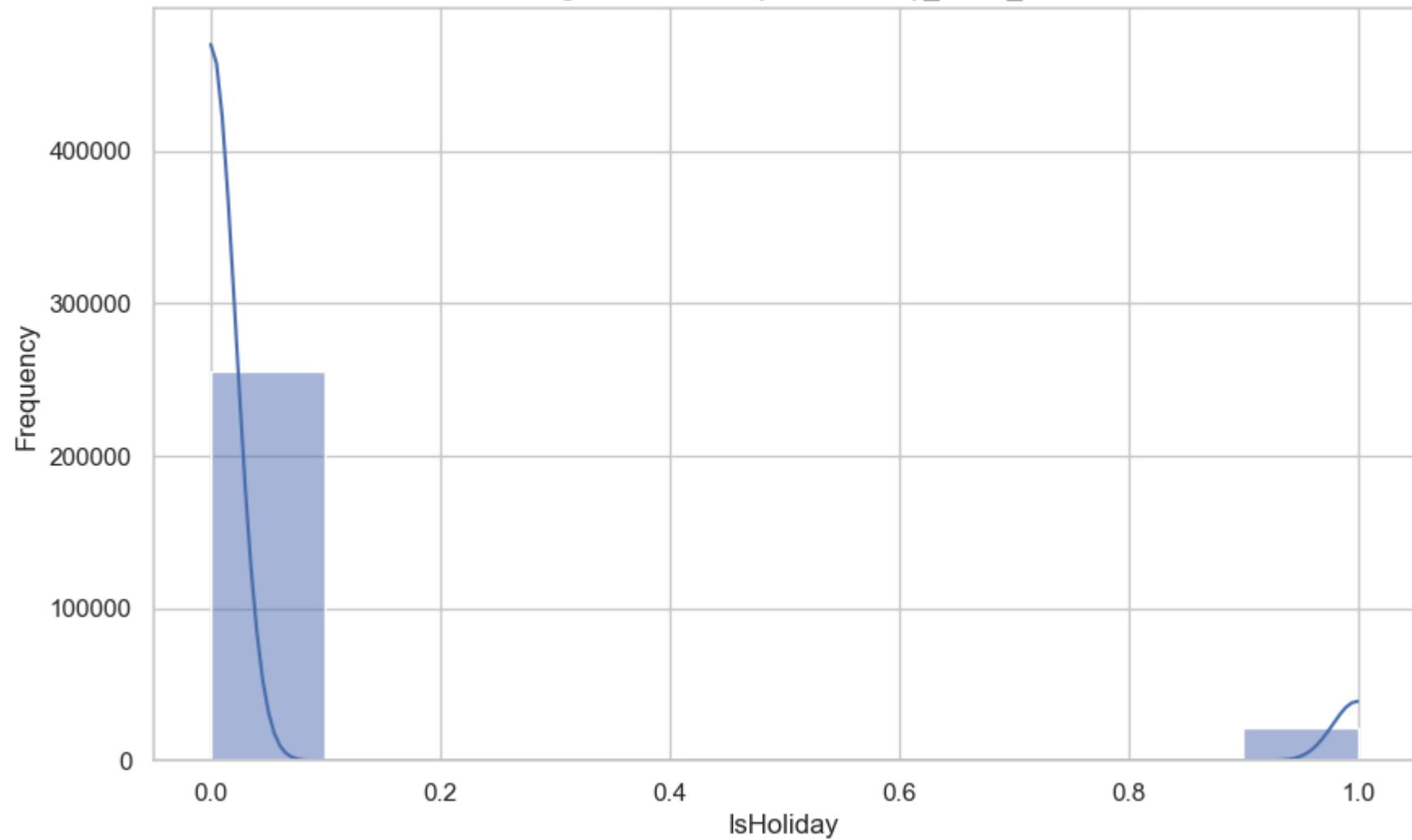


Box Plot of Weekly_Sales in Data with Weekly_Sales_11w

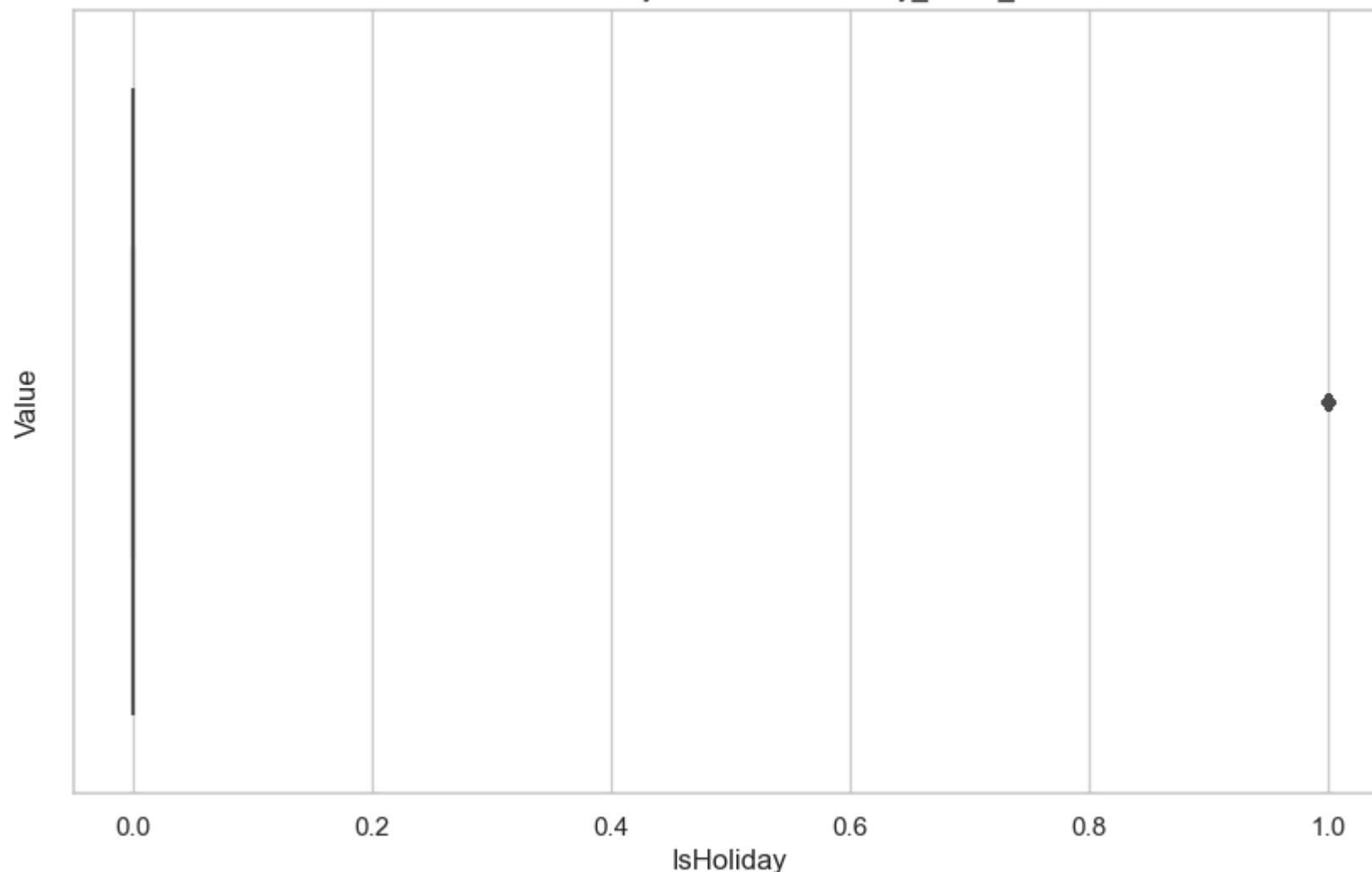


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_11w

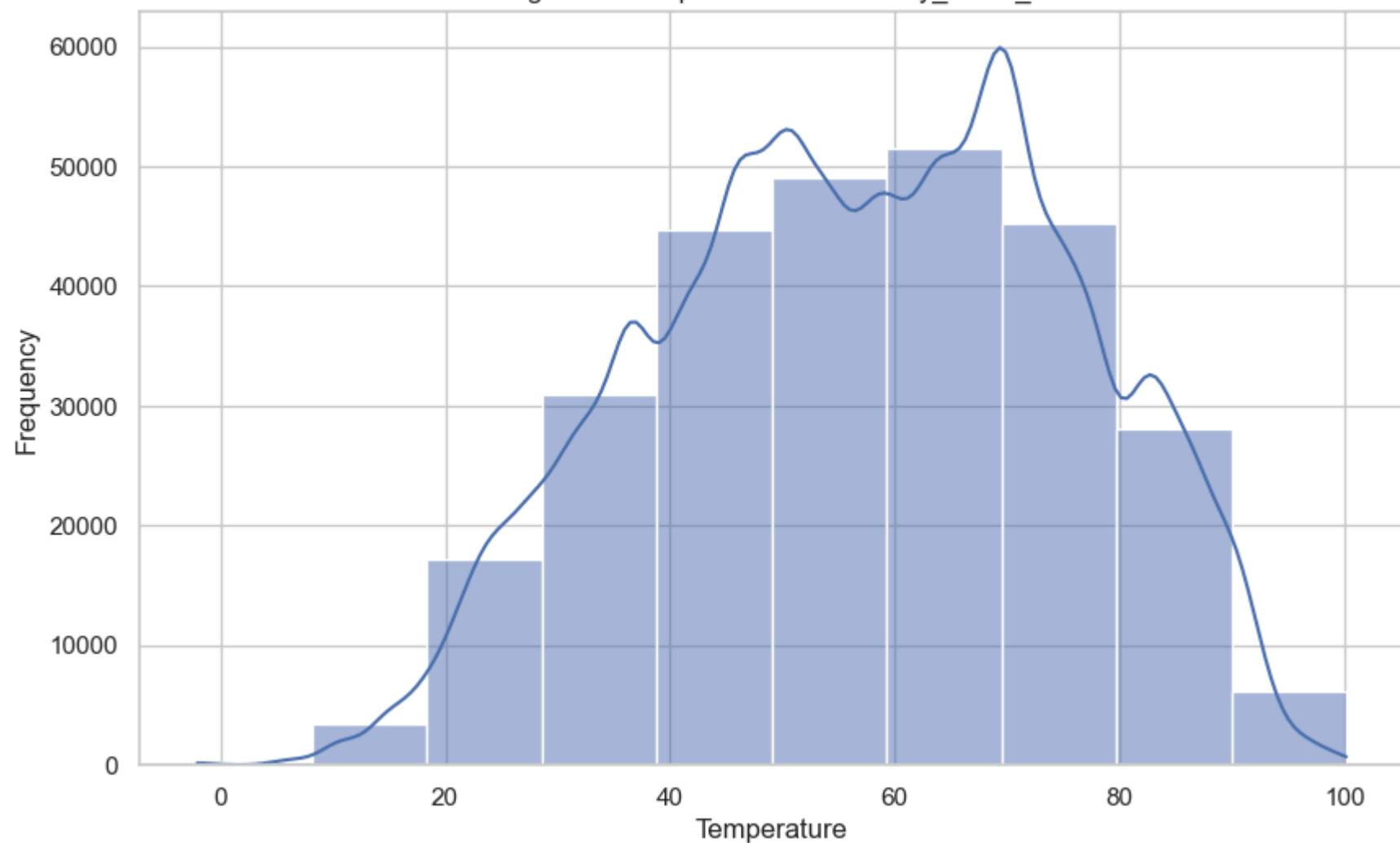


Box Plot of IsHoliday in Data with Weekly_Sales_11w

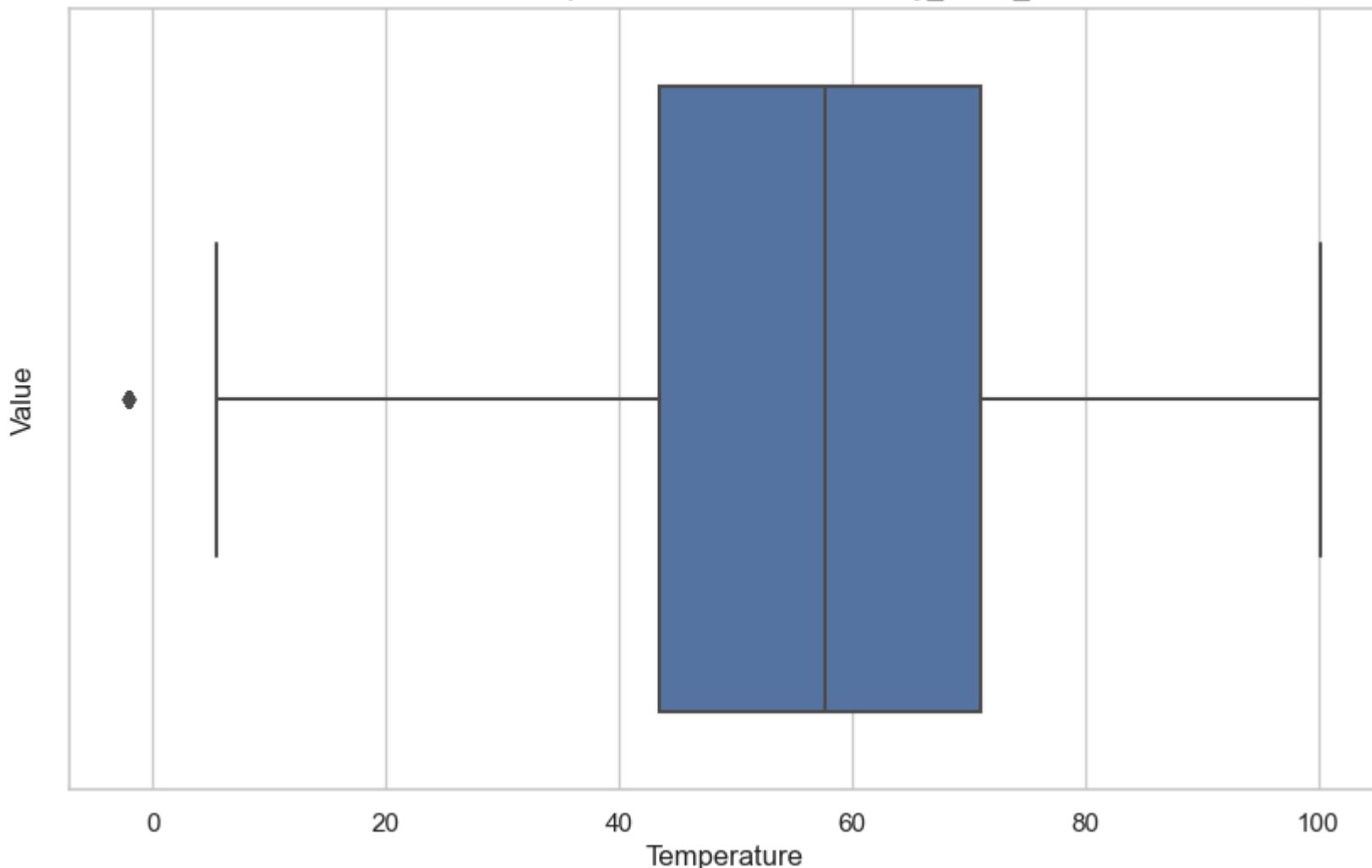


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_11w

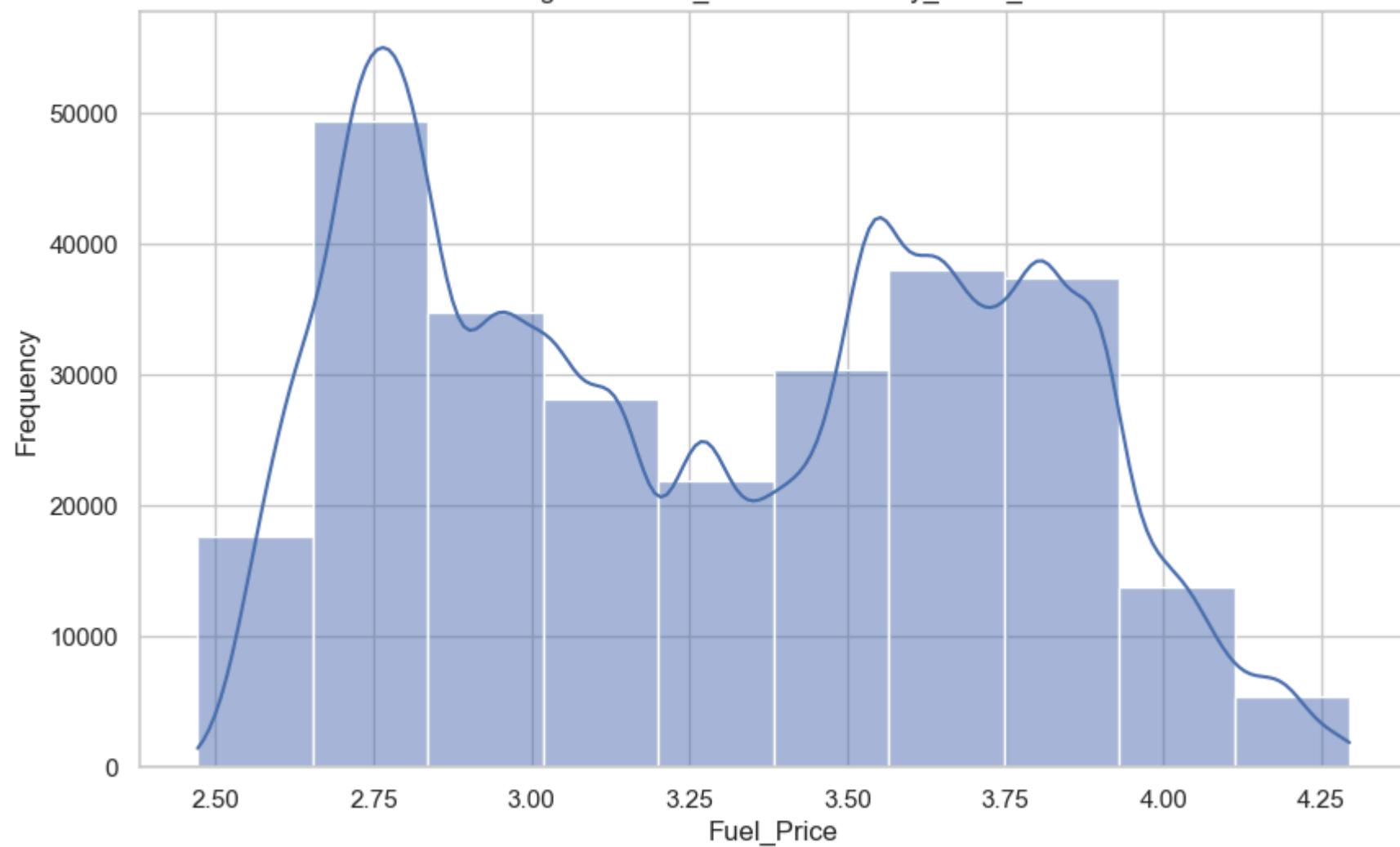


Box Plot of Temperature in Data with Weekly_Sales_11w

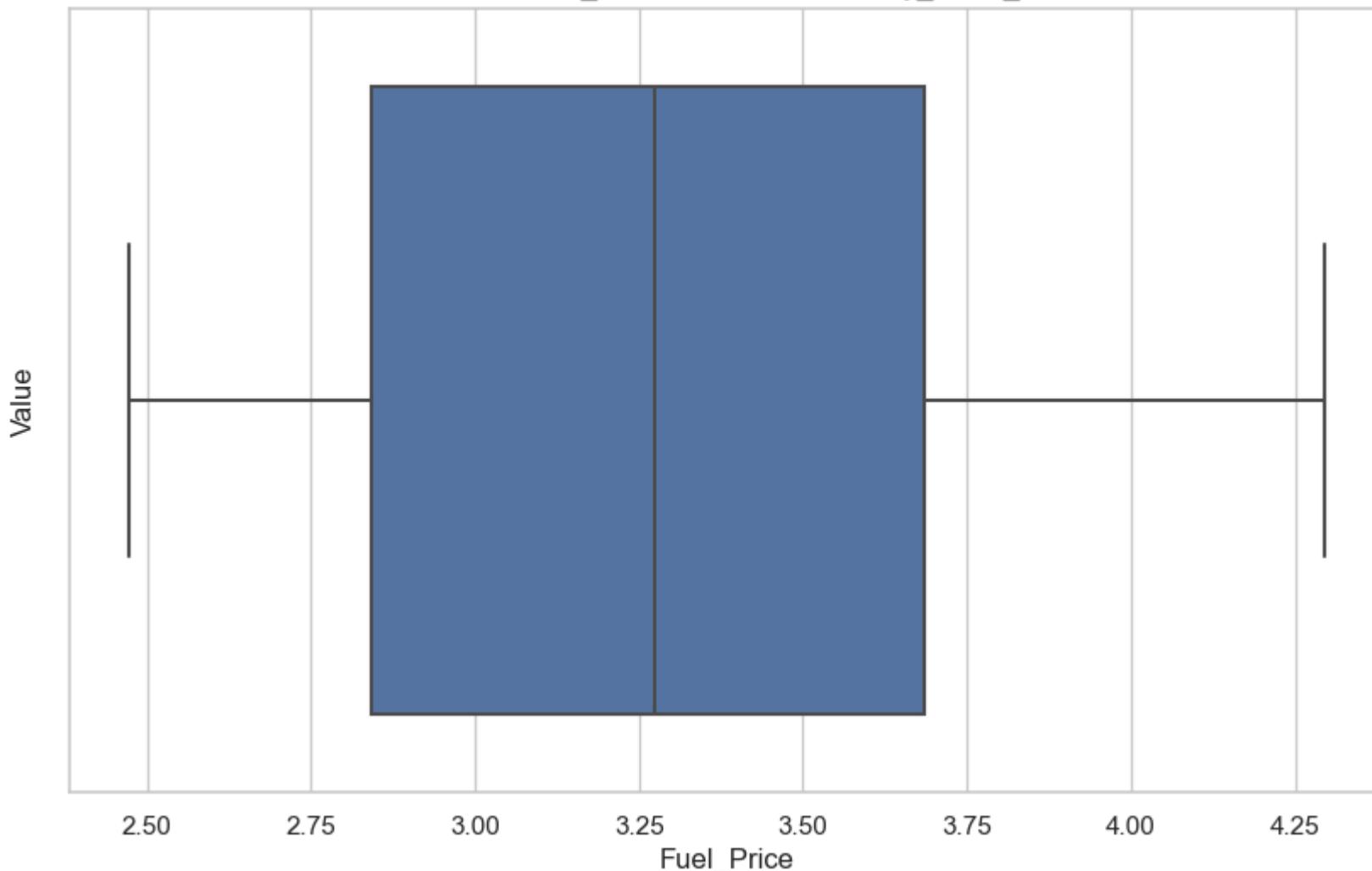


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Fuel_Price with Weekly_Sales_11w

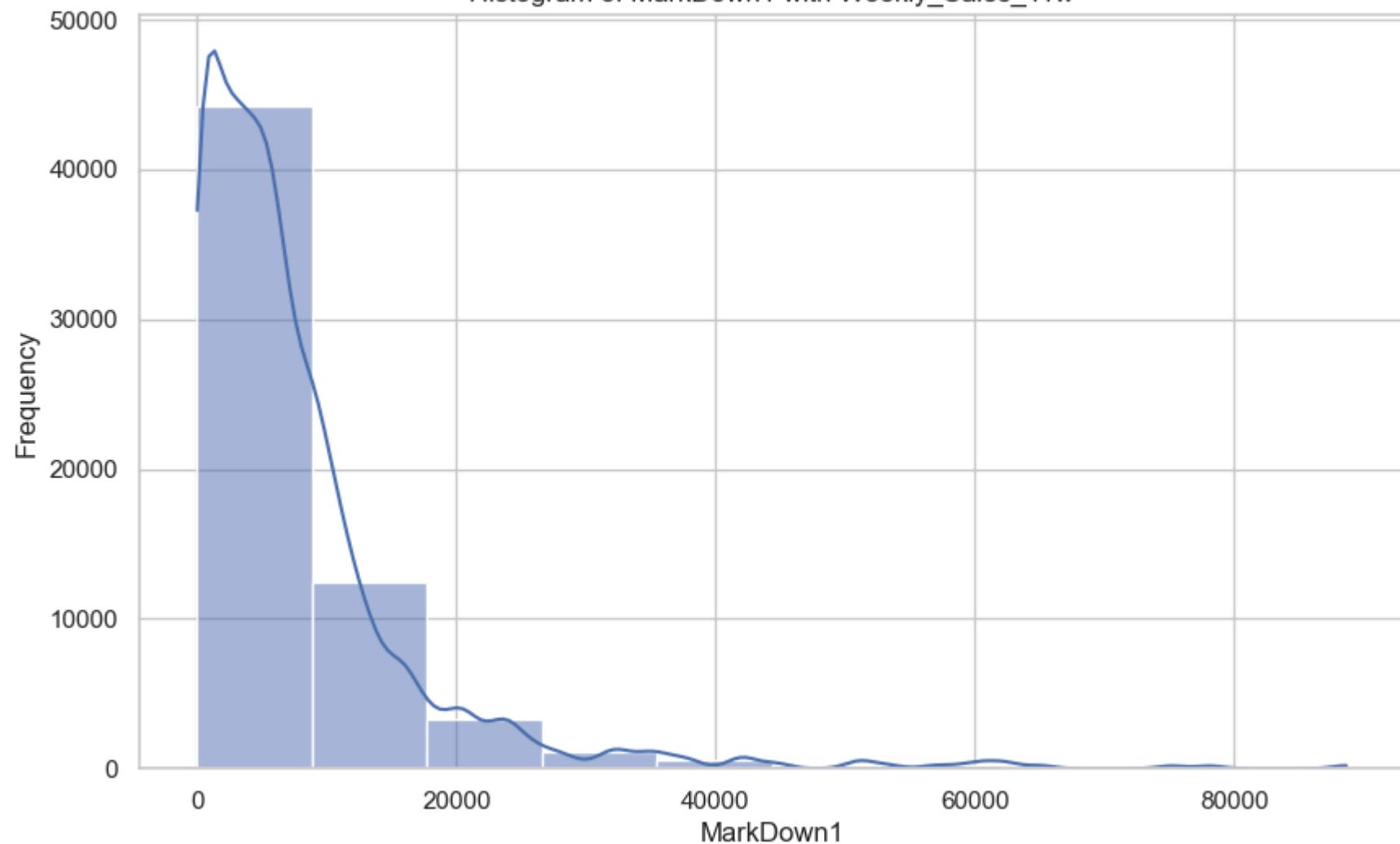


Box Plot of Fuel_Price in Data with Weekly_Sales_11w

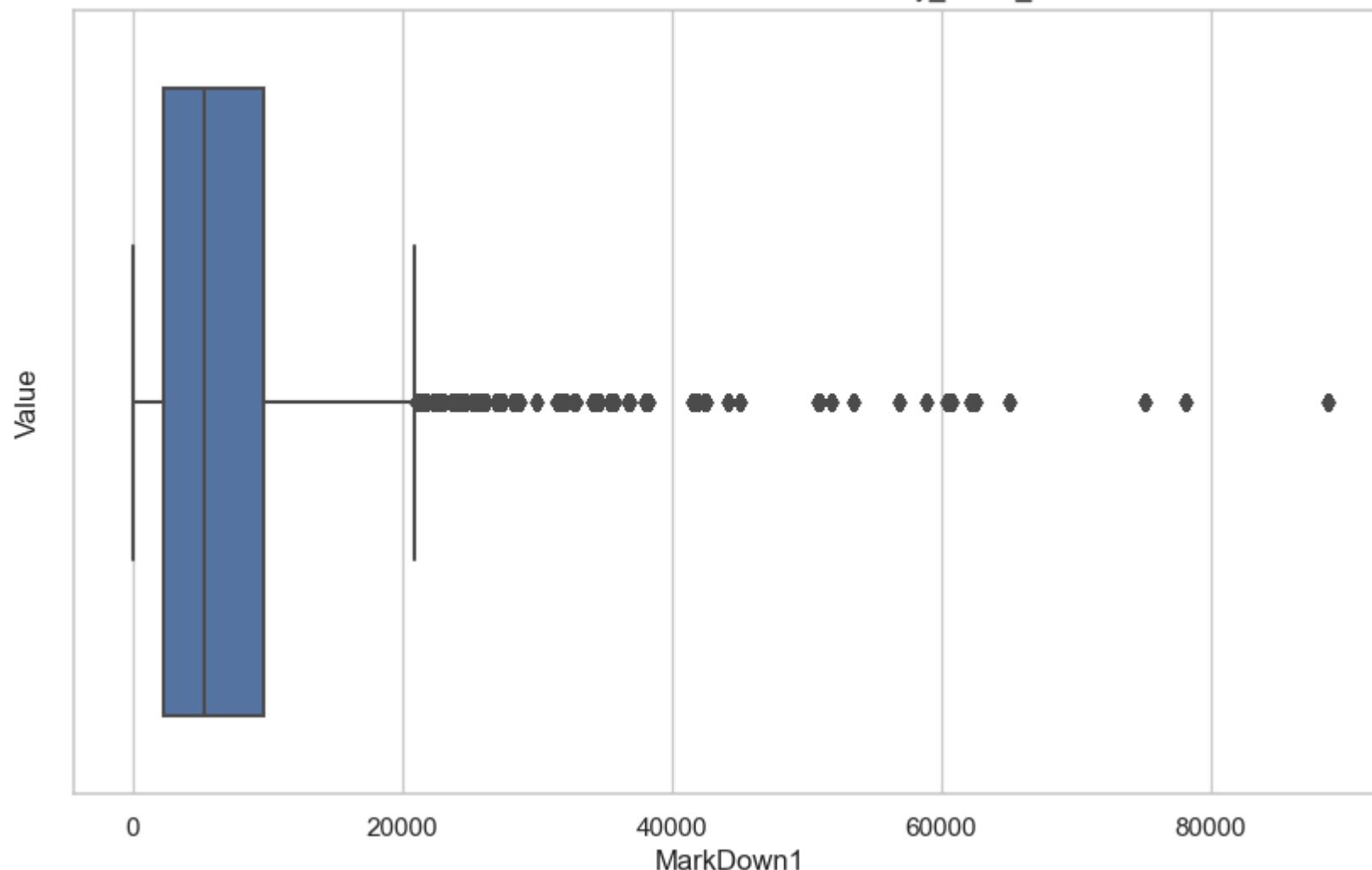


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown1 with Weekly_Sales_11w

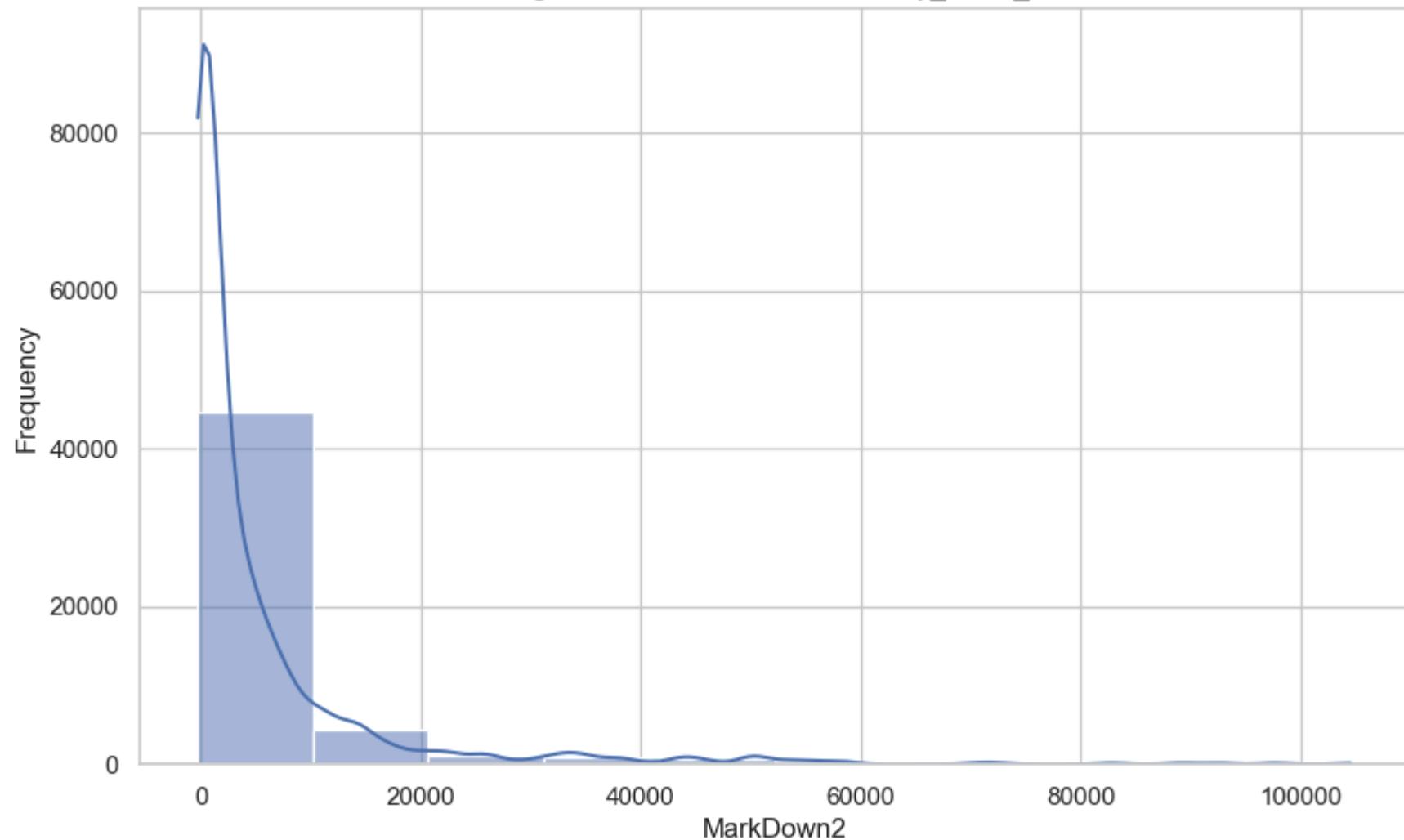


Box Plot of MarkDown1 in Data with Weekly_Sales_11w

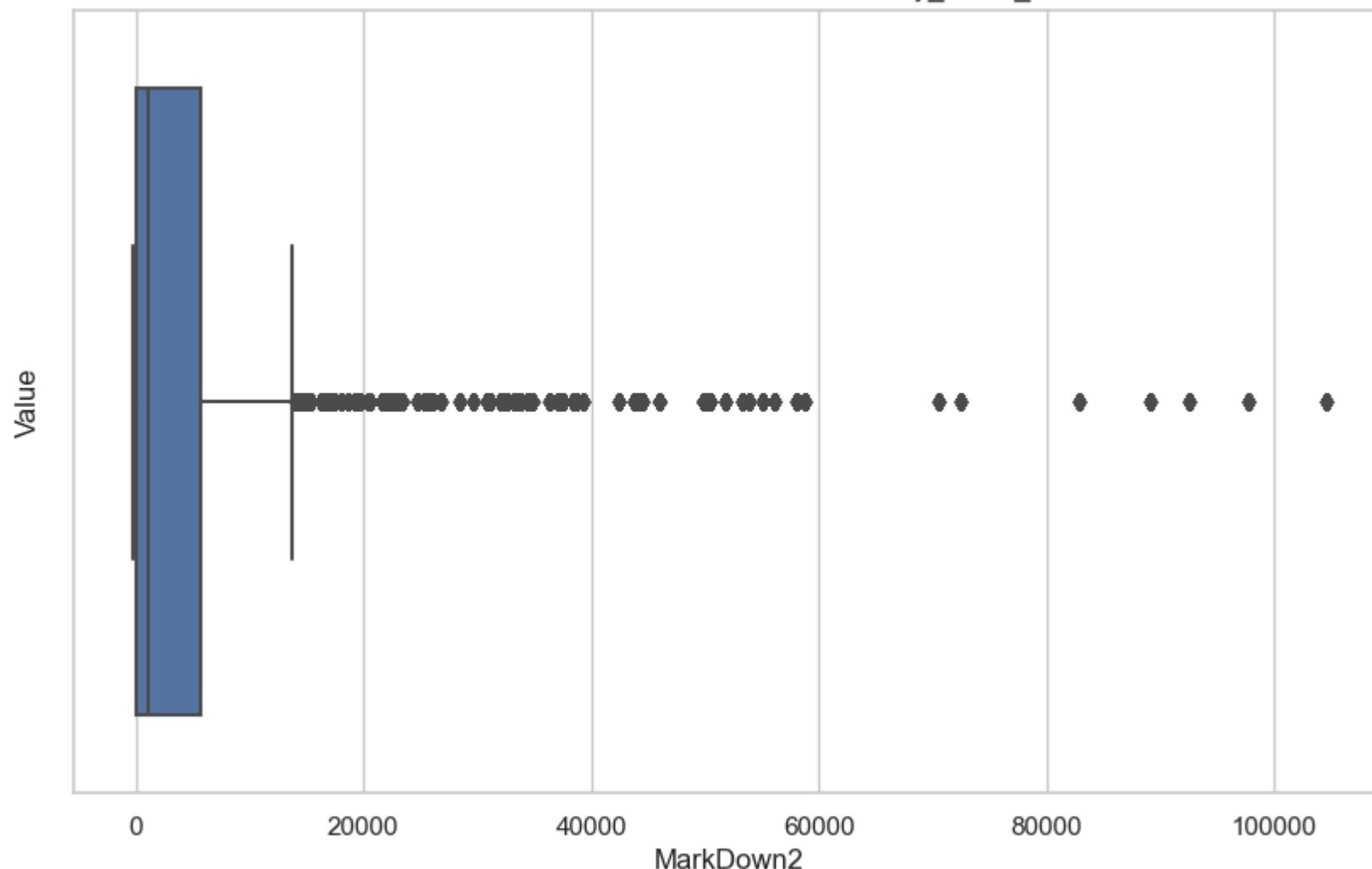


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_11w

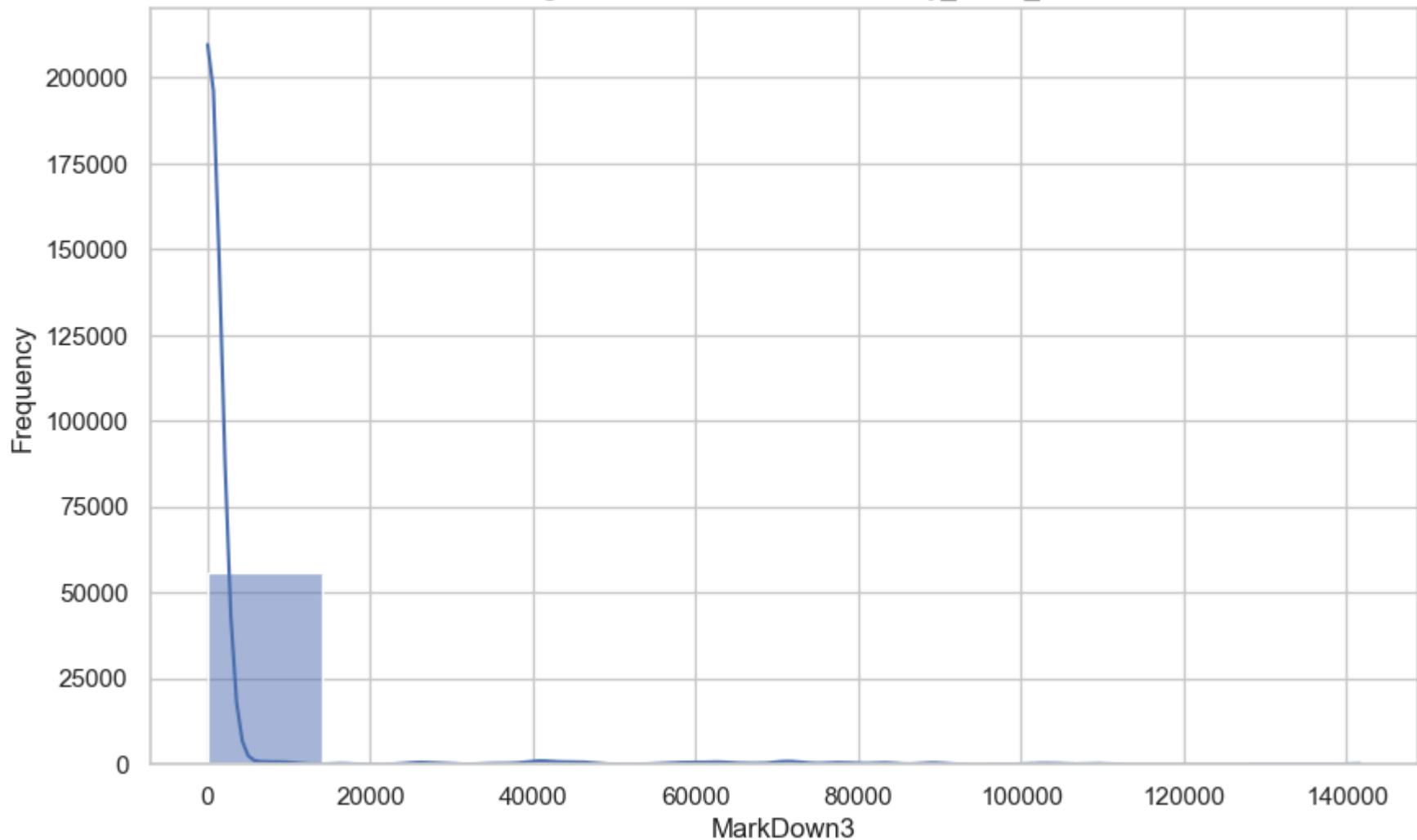


Box Plot of MarkDown2 in Data with Weekly_Sales_11w

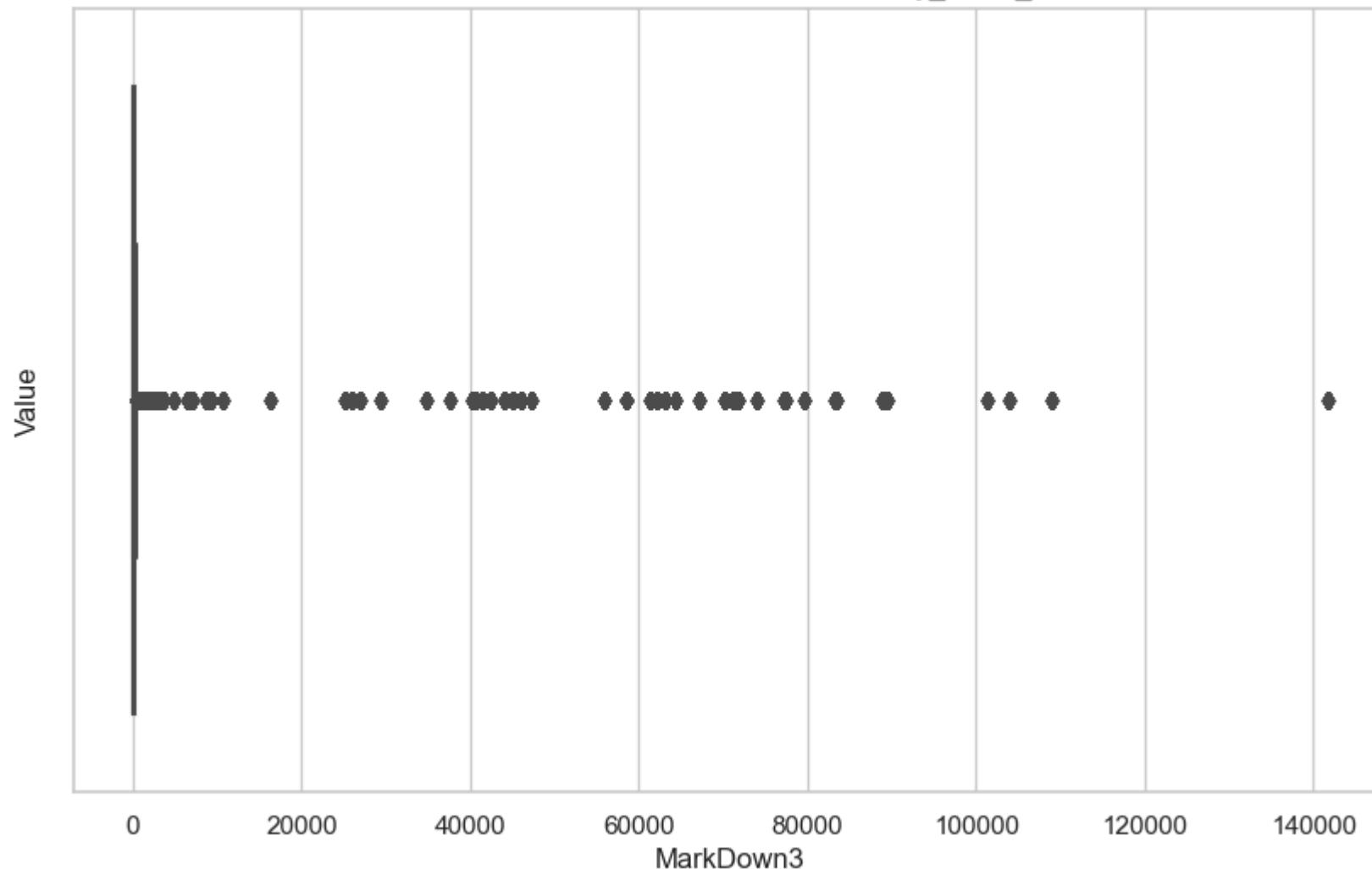


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_11w

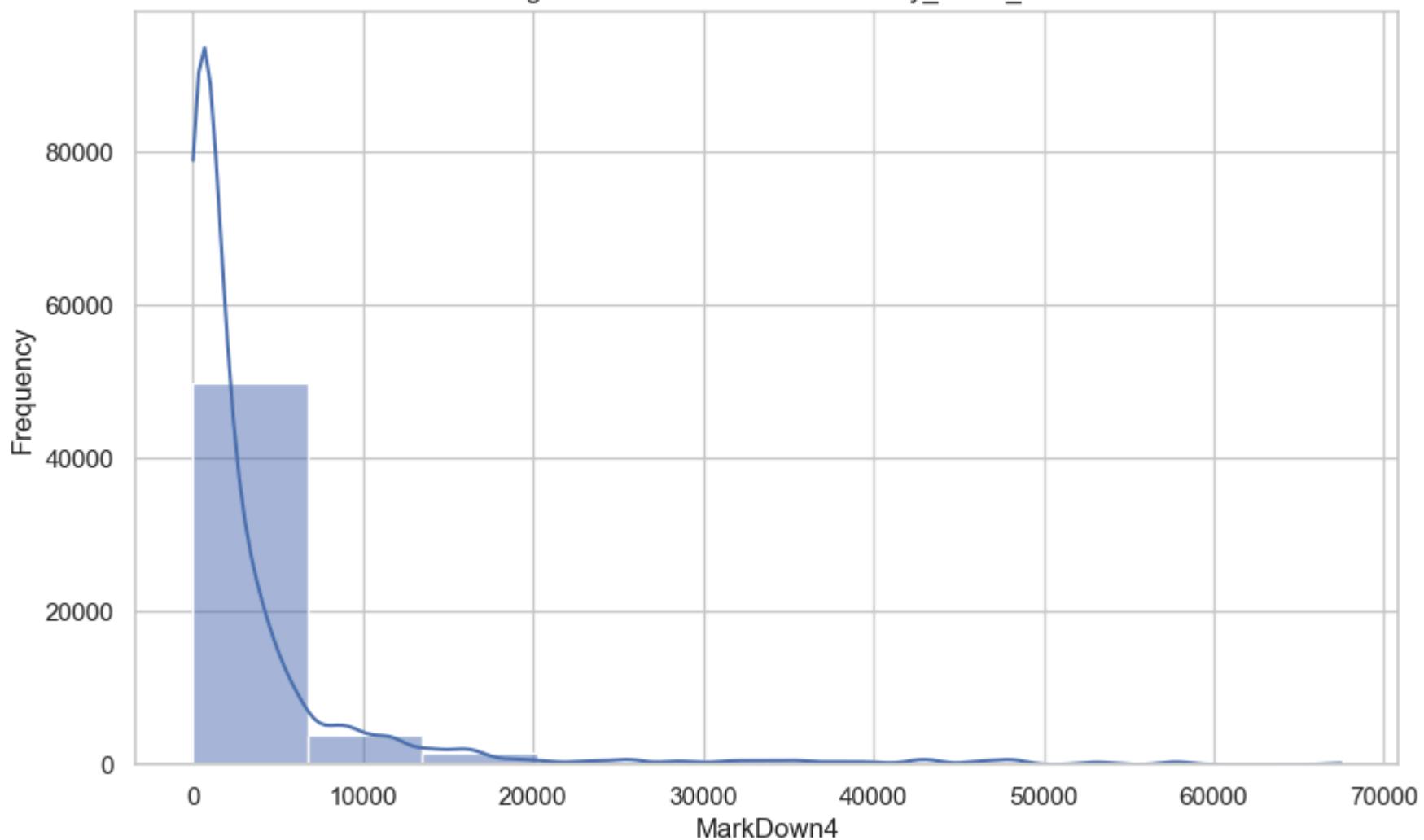


Box Plot of MarkDown3 in Data with Weekly_Sales_11w

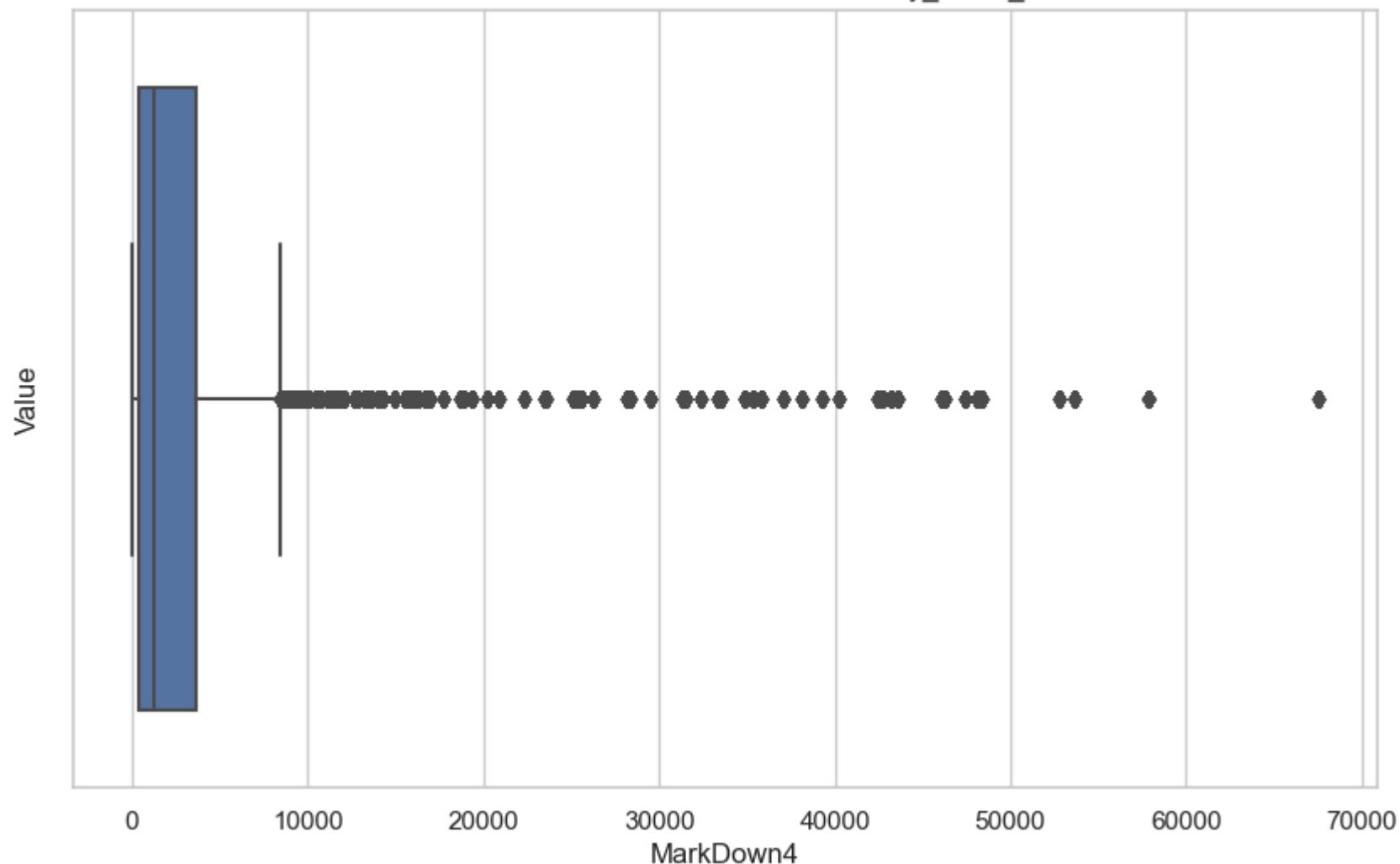


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_11w

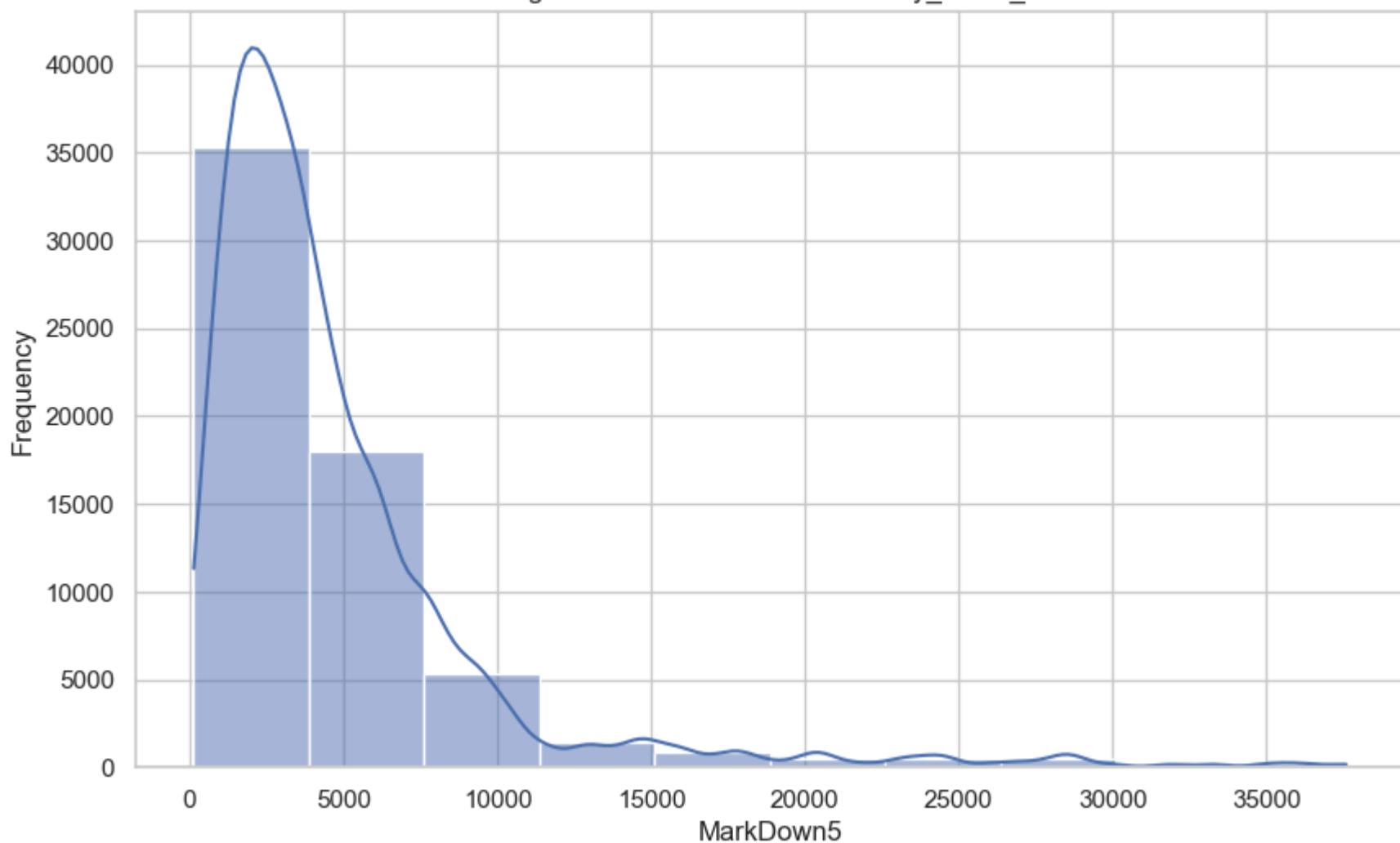


Box Plot of MarkDown4 in Data with Weekly_Sales_11w

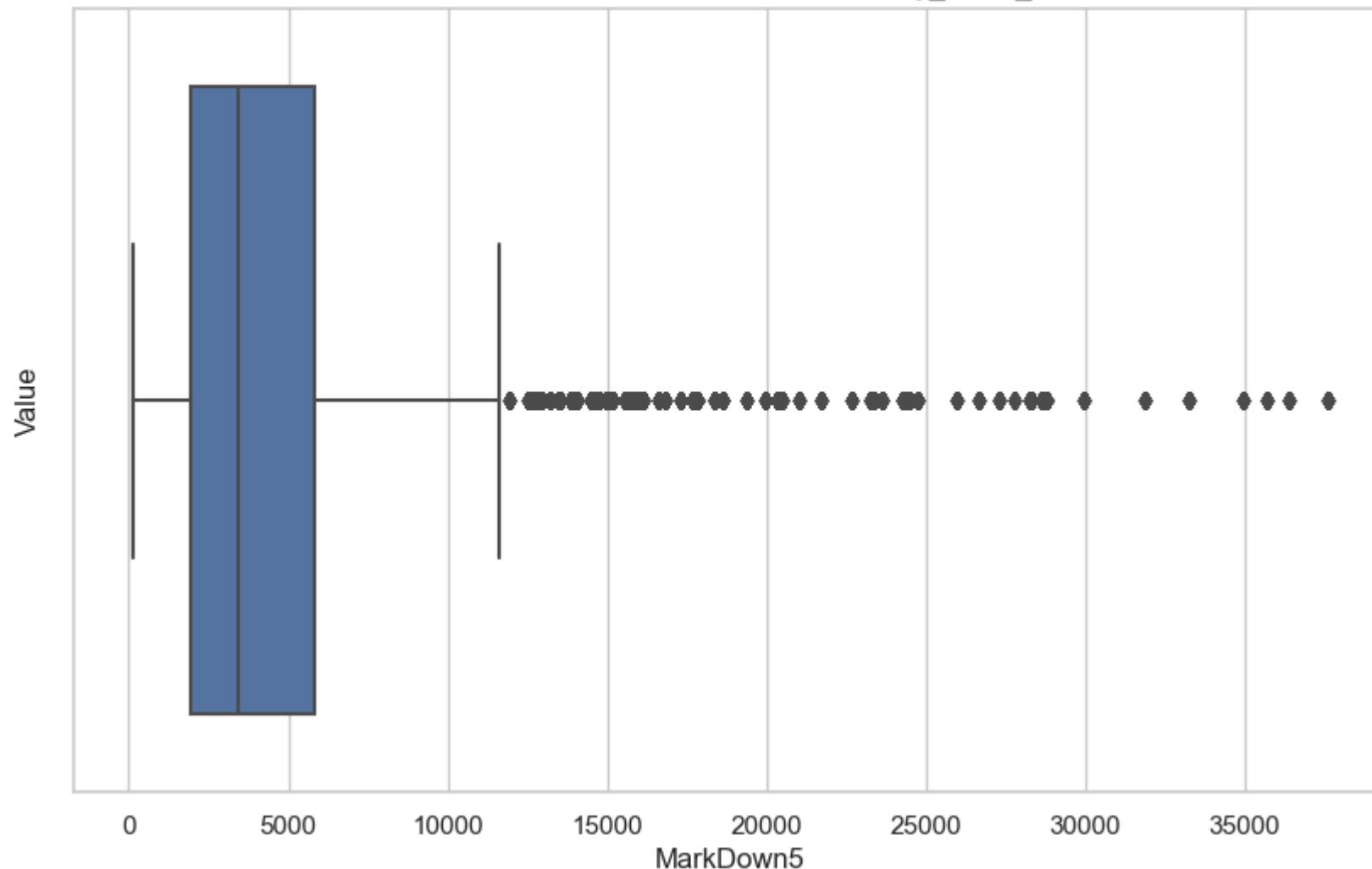


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_11w

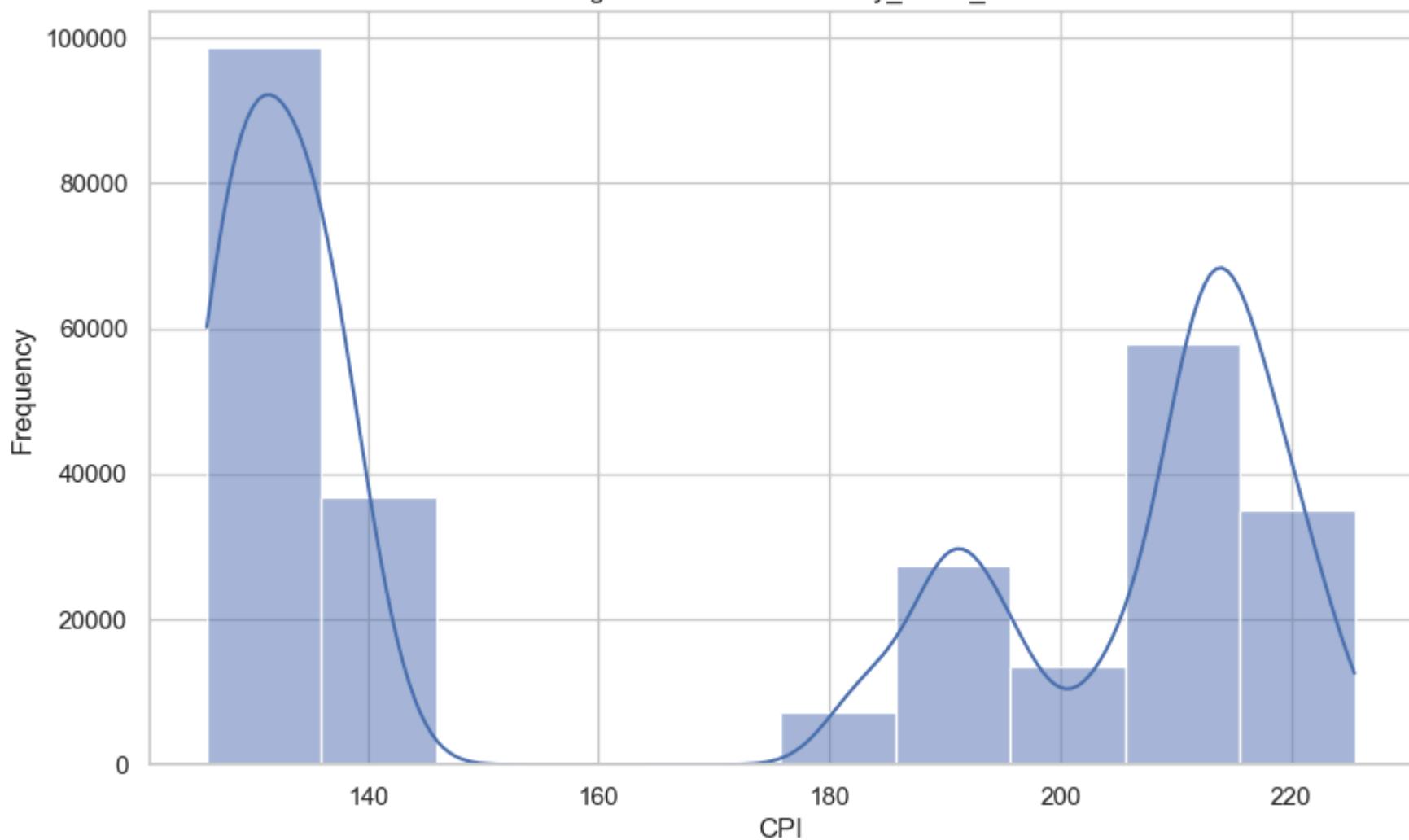


Box Plot of MarkDown5 in Data with Weekly_Sales_11w

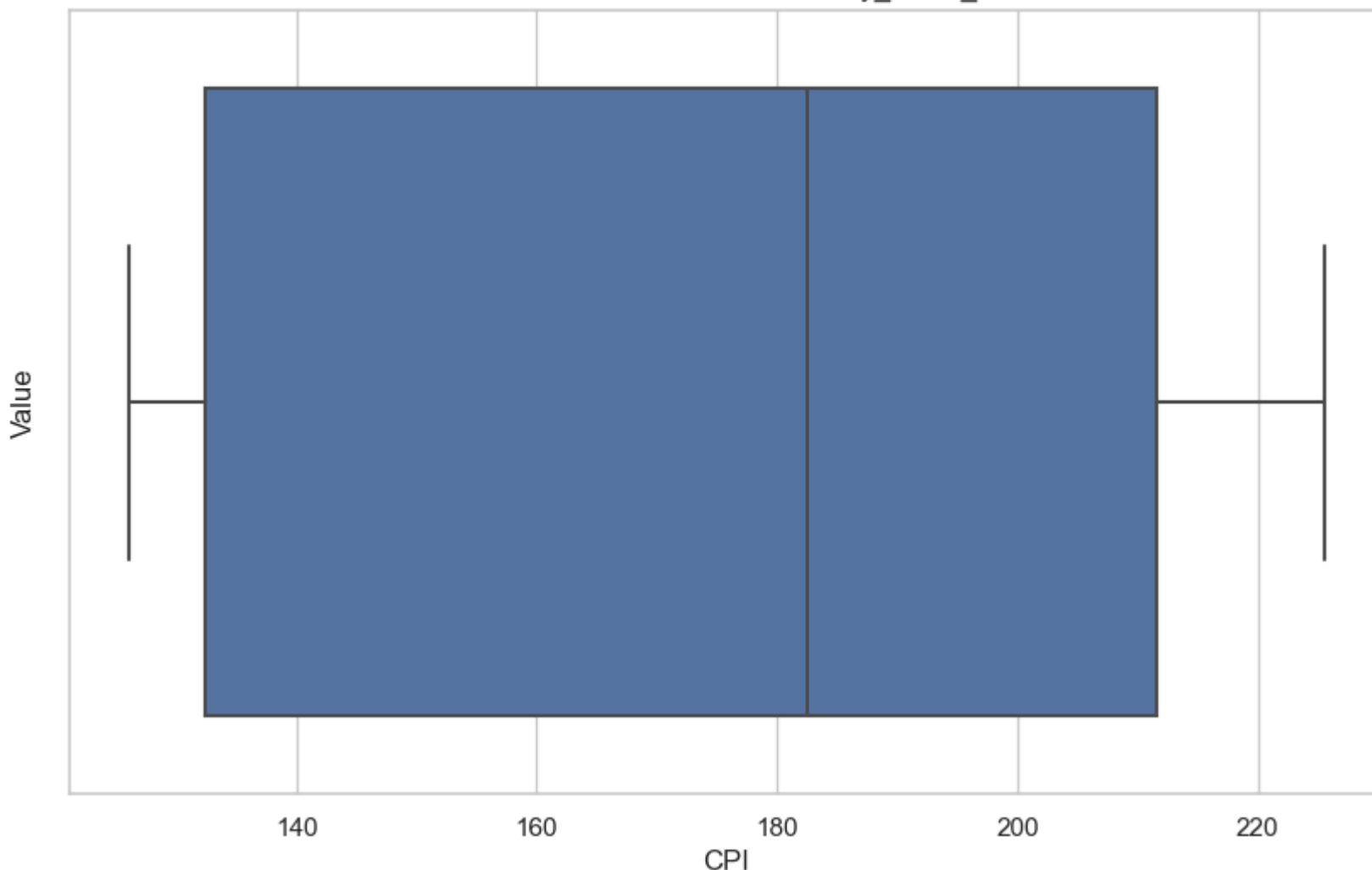


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_11w

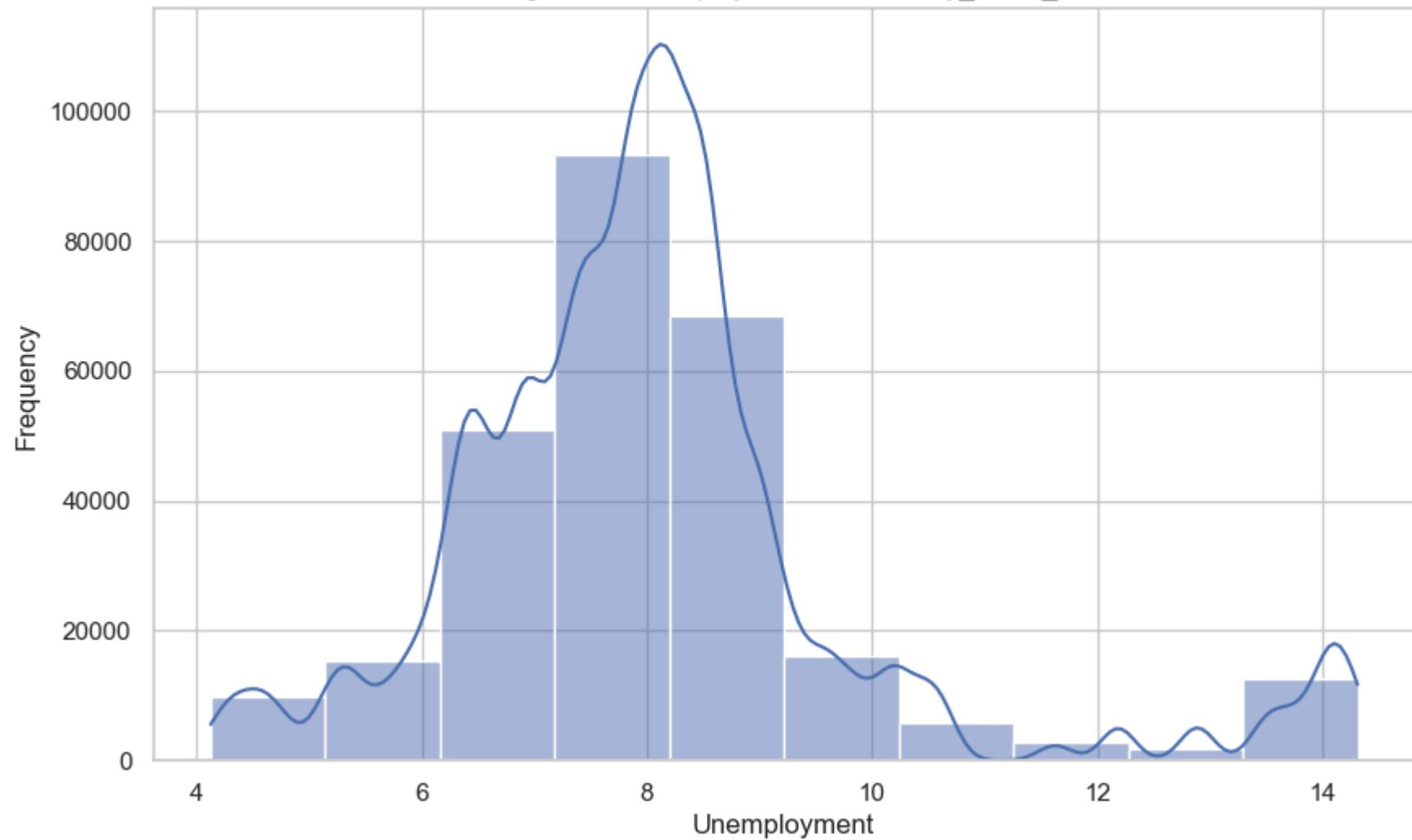


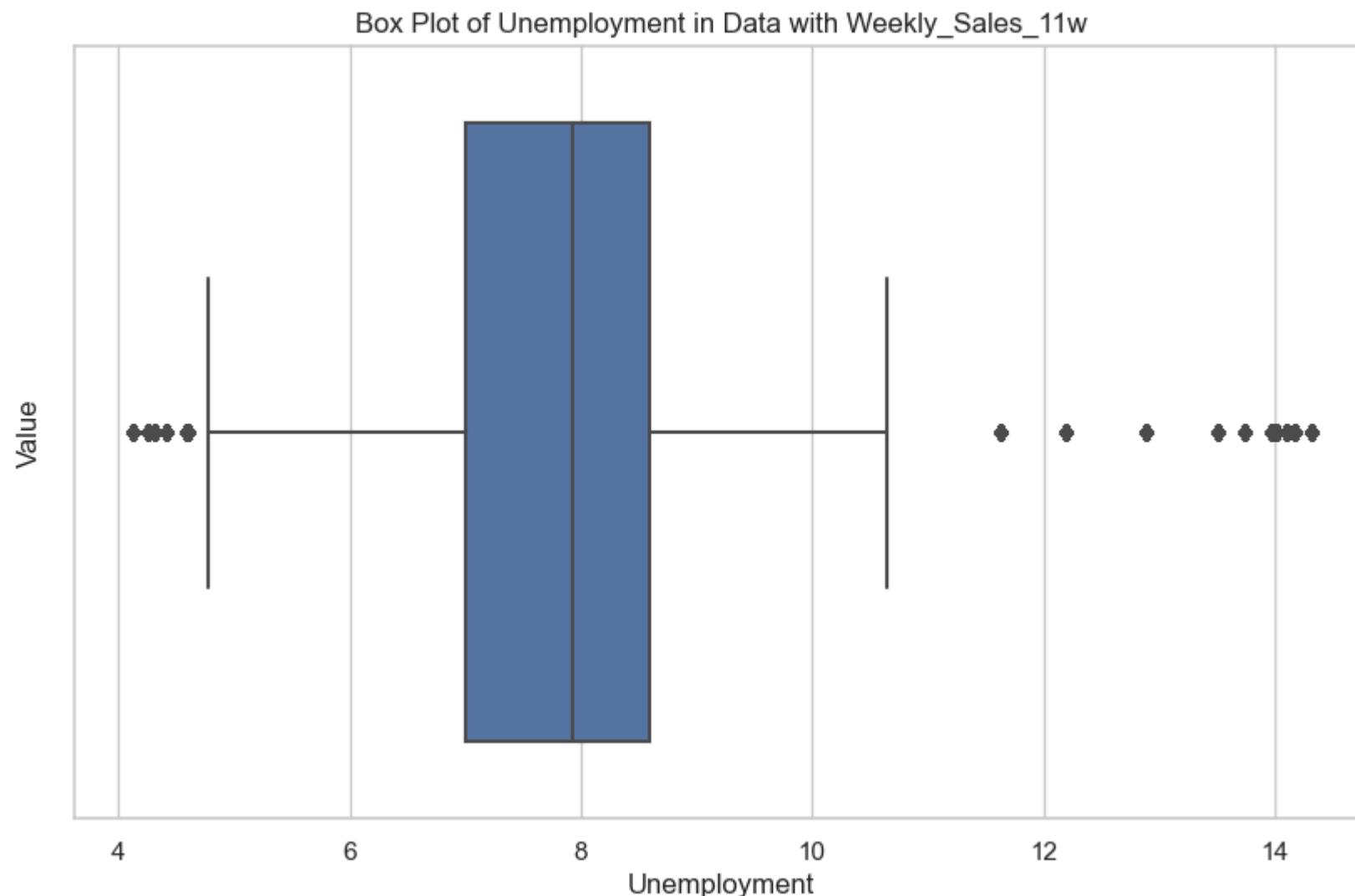
Box Plot of CPI in Data with Weekly_Sales_11w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

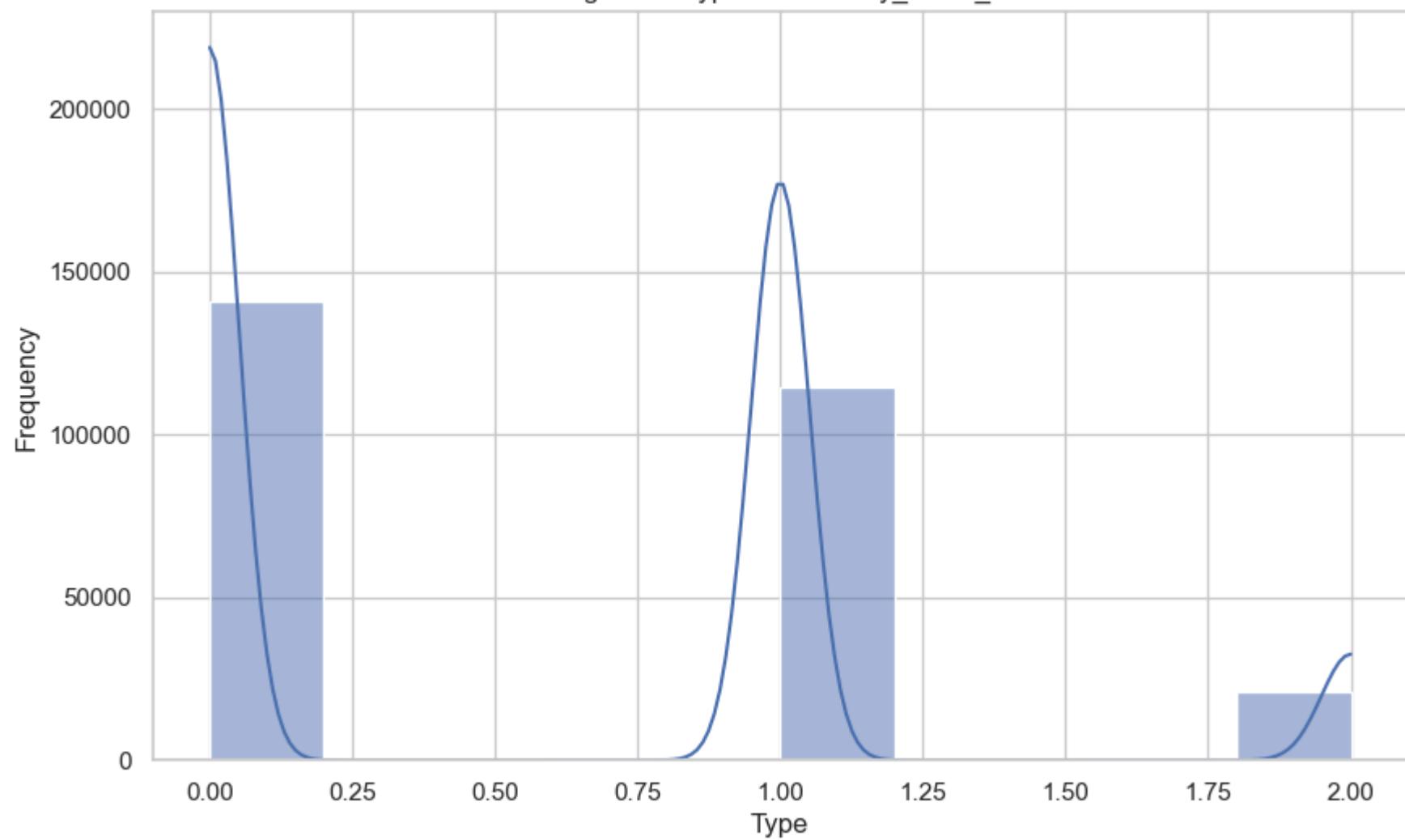
Histogram of Unemployment with Weekly_Sales_11w



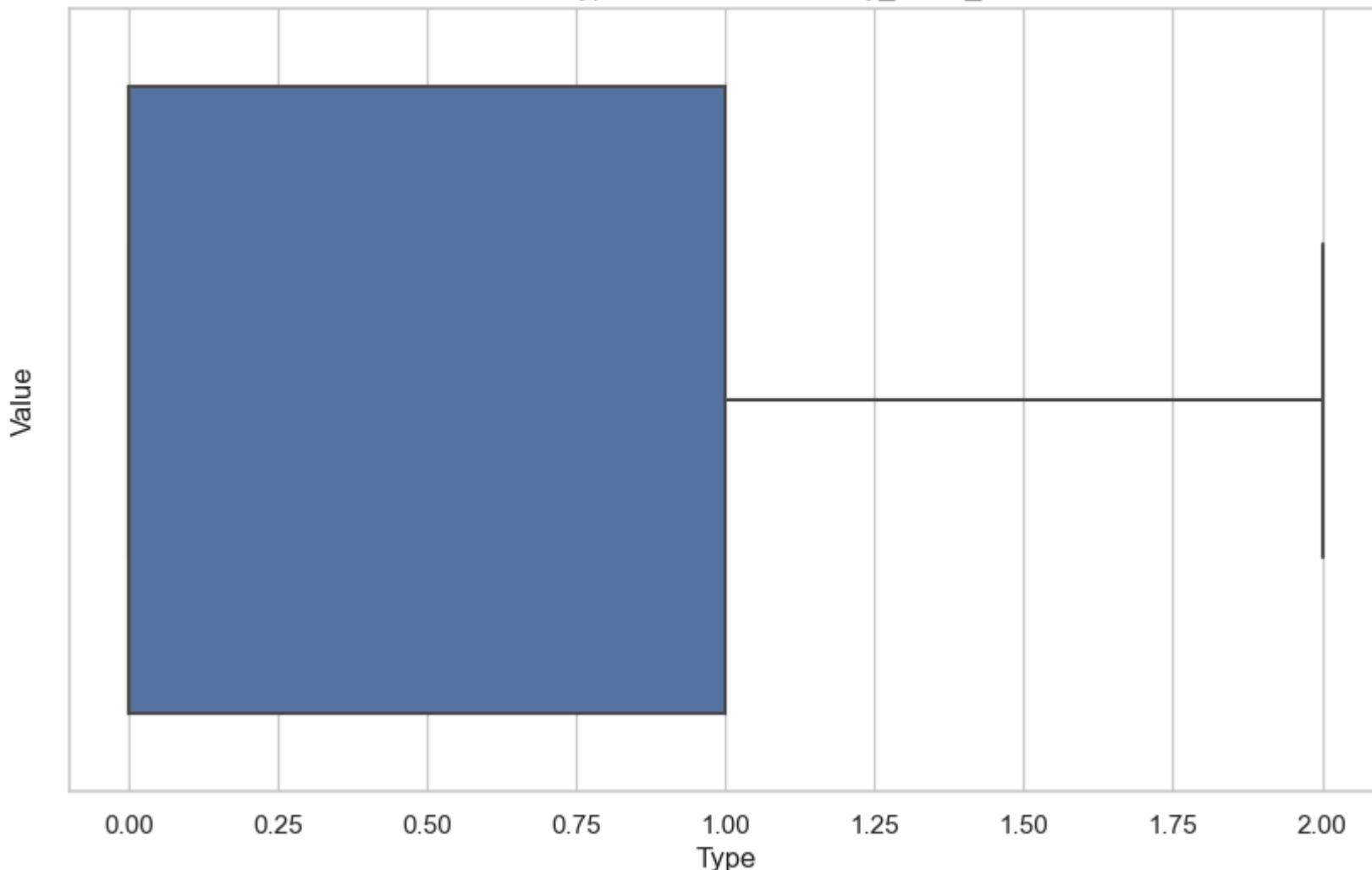


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Type with Weekly_Sales_11w

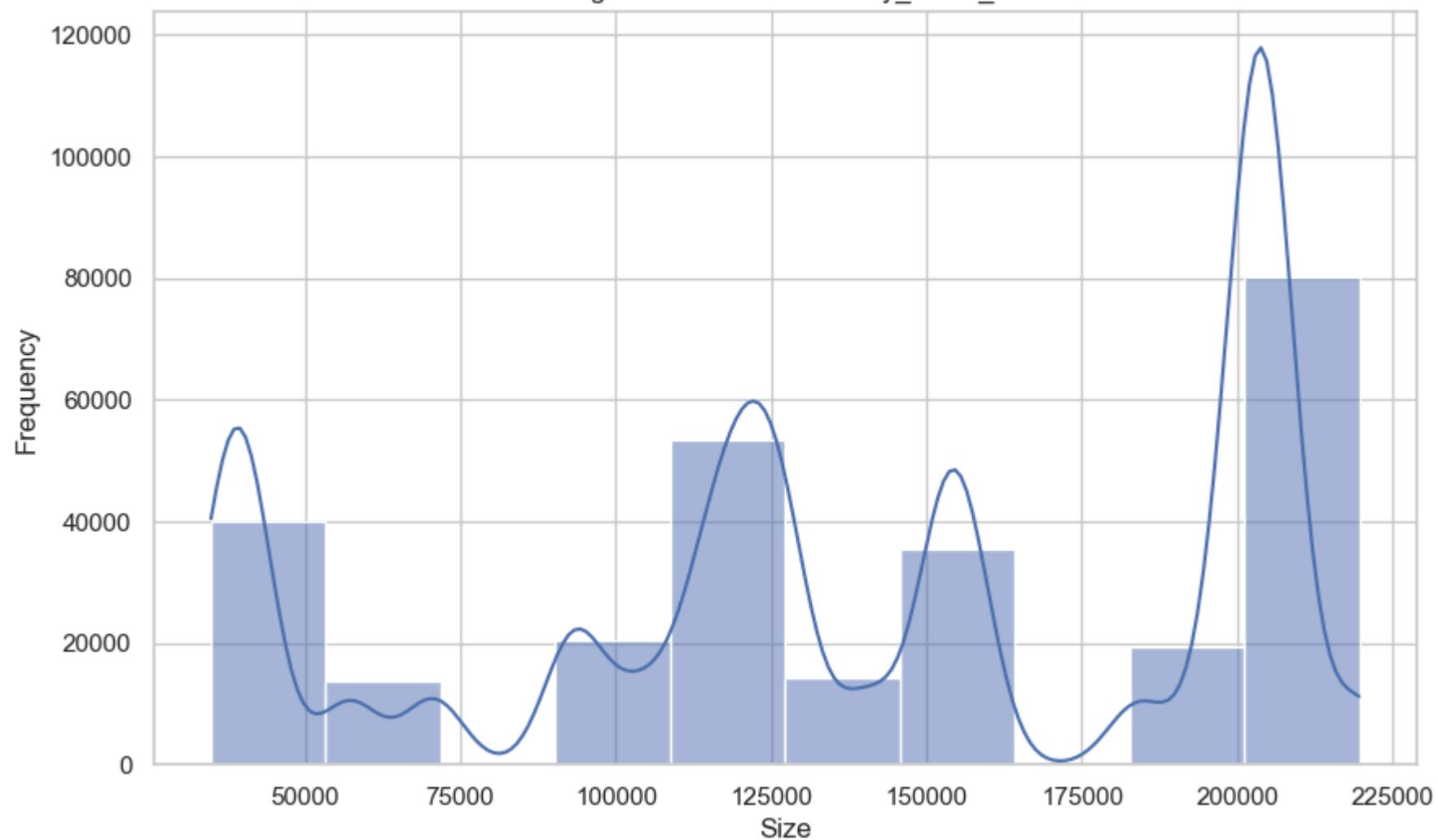


Box Plot of Type in Data with Weekly_Sales_11w

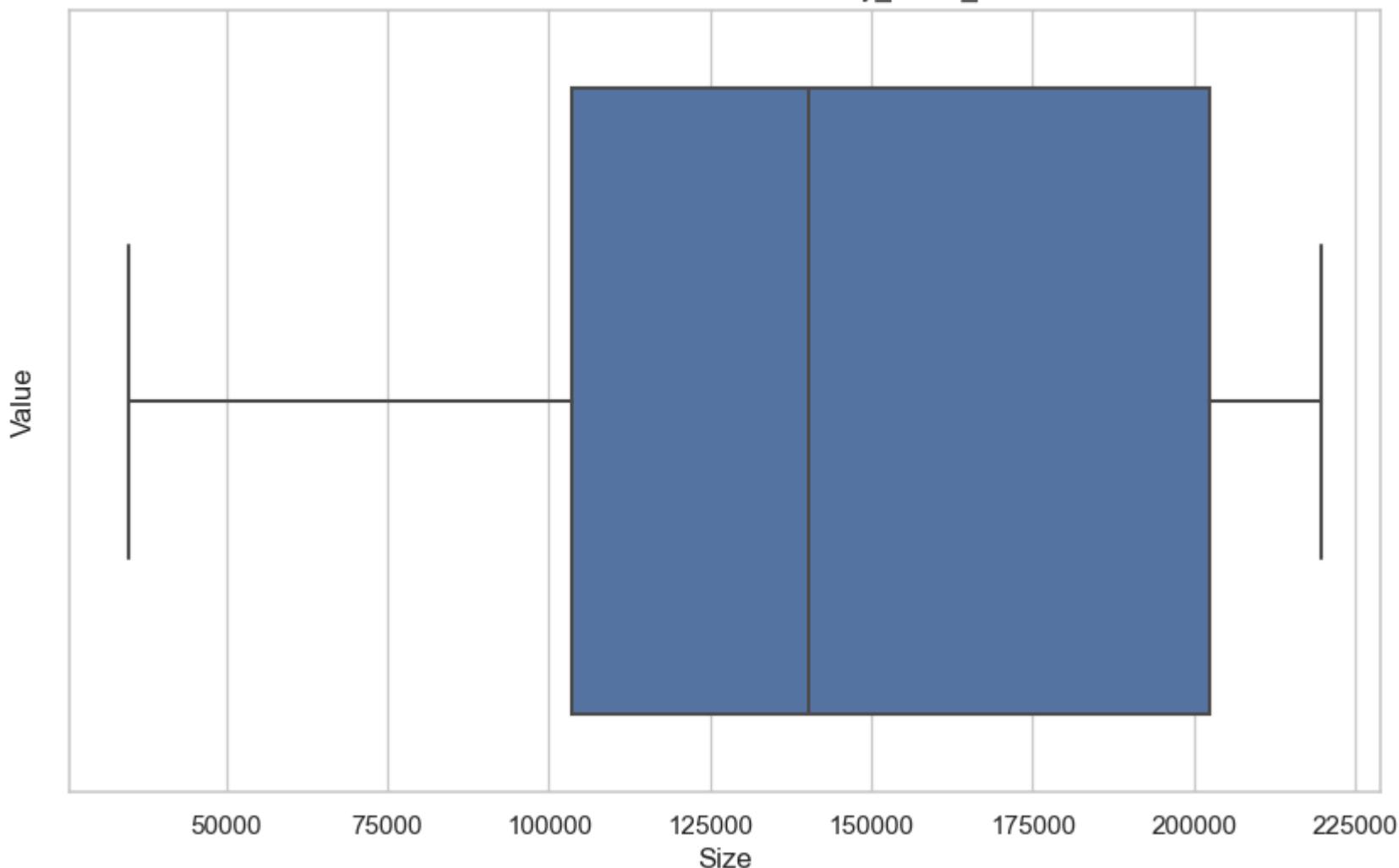


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Size with Weekly_Sales_11w

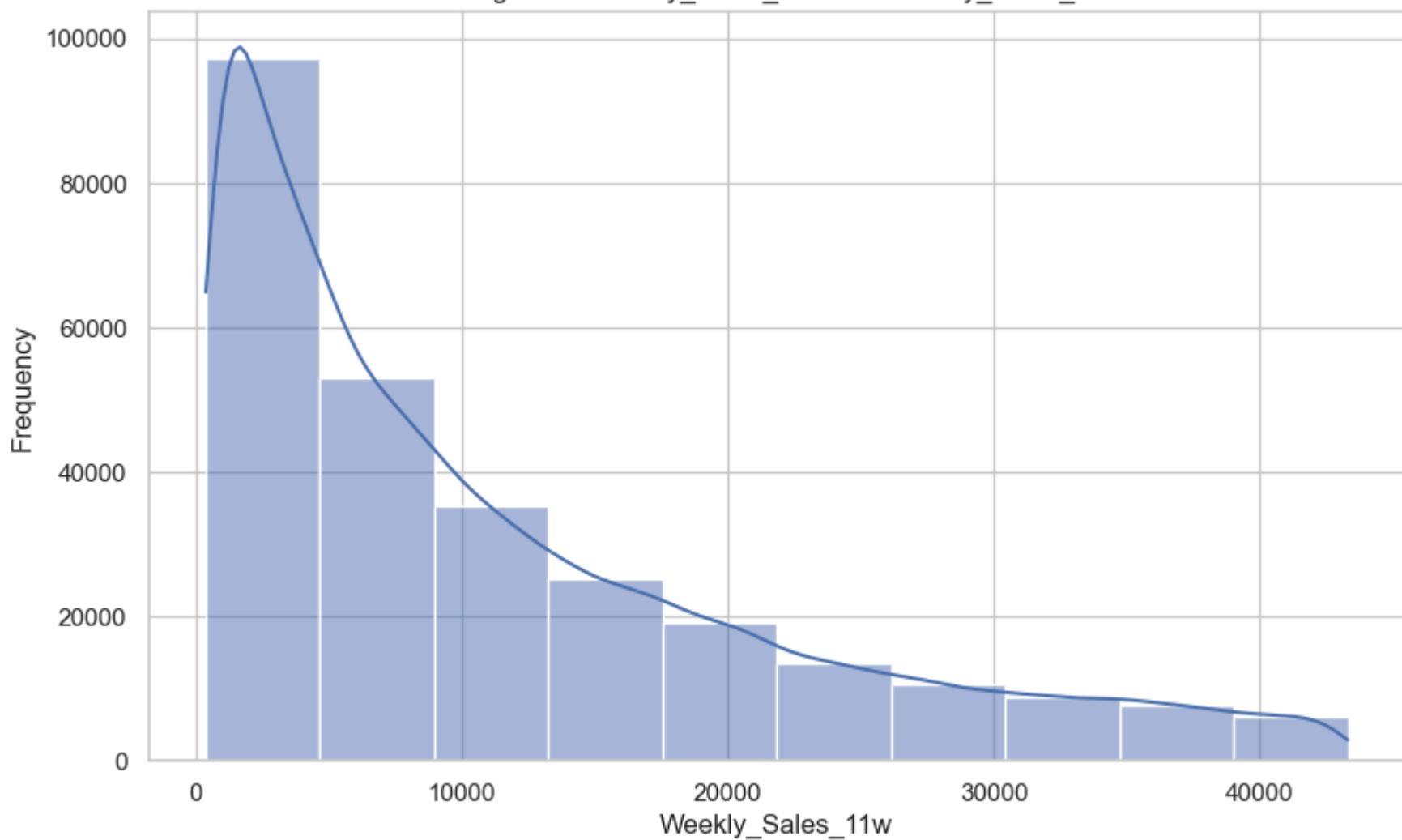


Box Plot of Size in Data with Weekly_Sales_11w

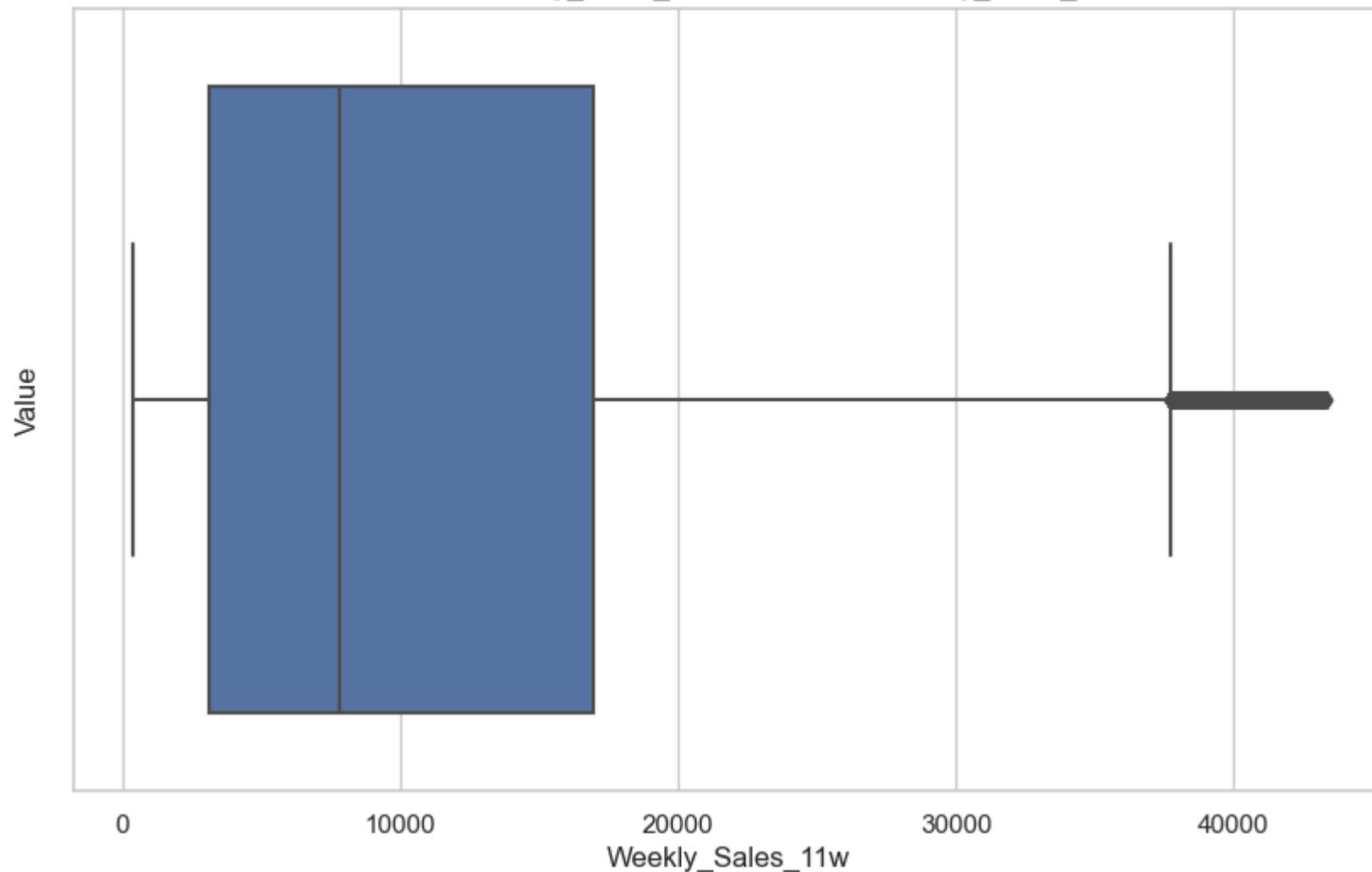


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_11w with Weekly_Sales_11w

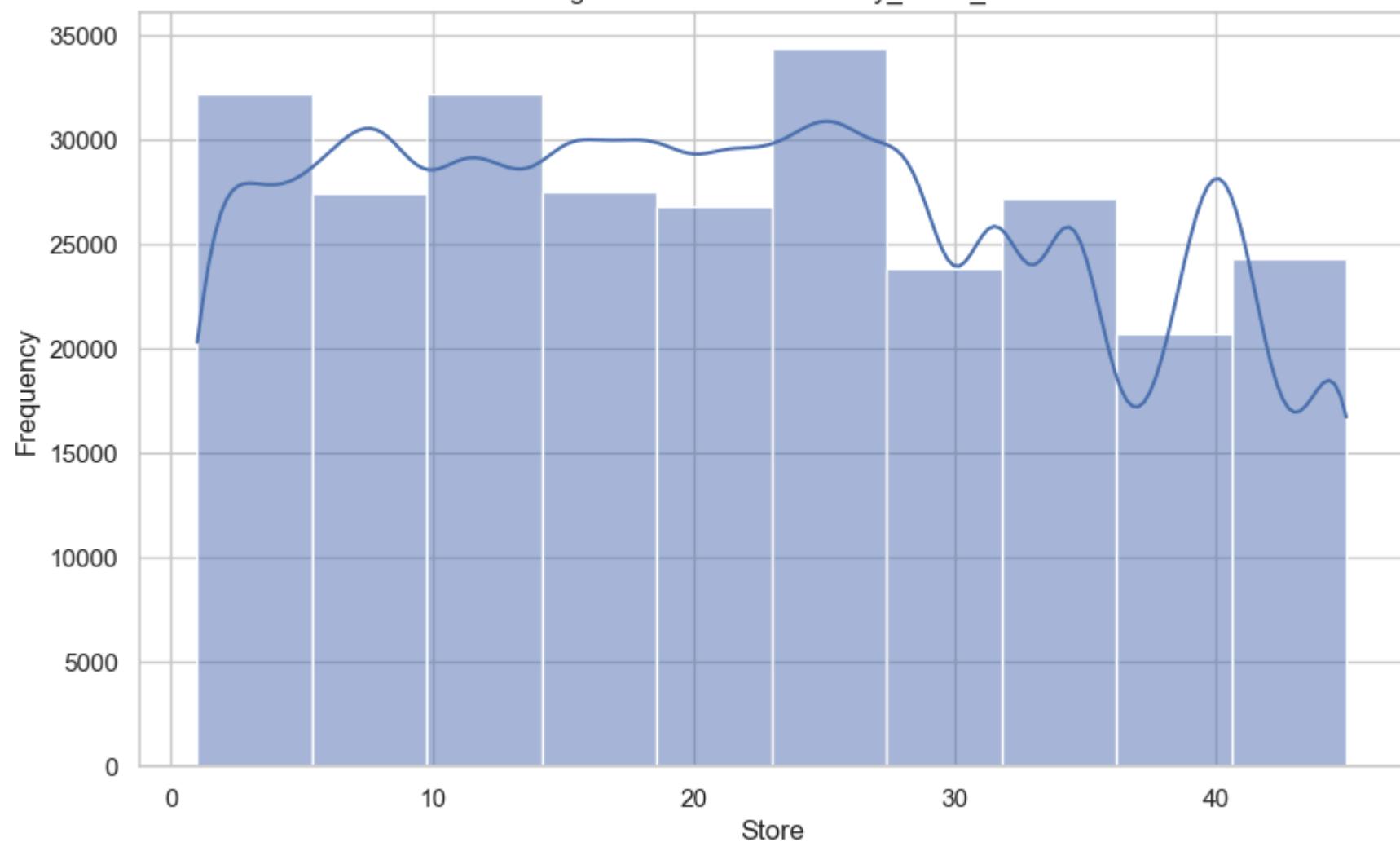


Box Plot of Weekly_Sales_11w in Data with Weekly_Sales_11w

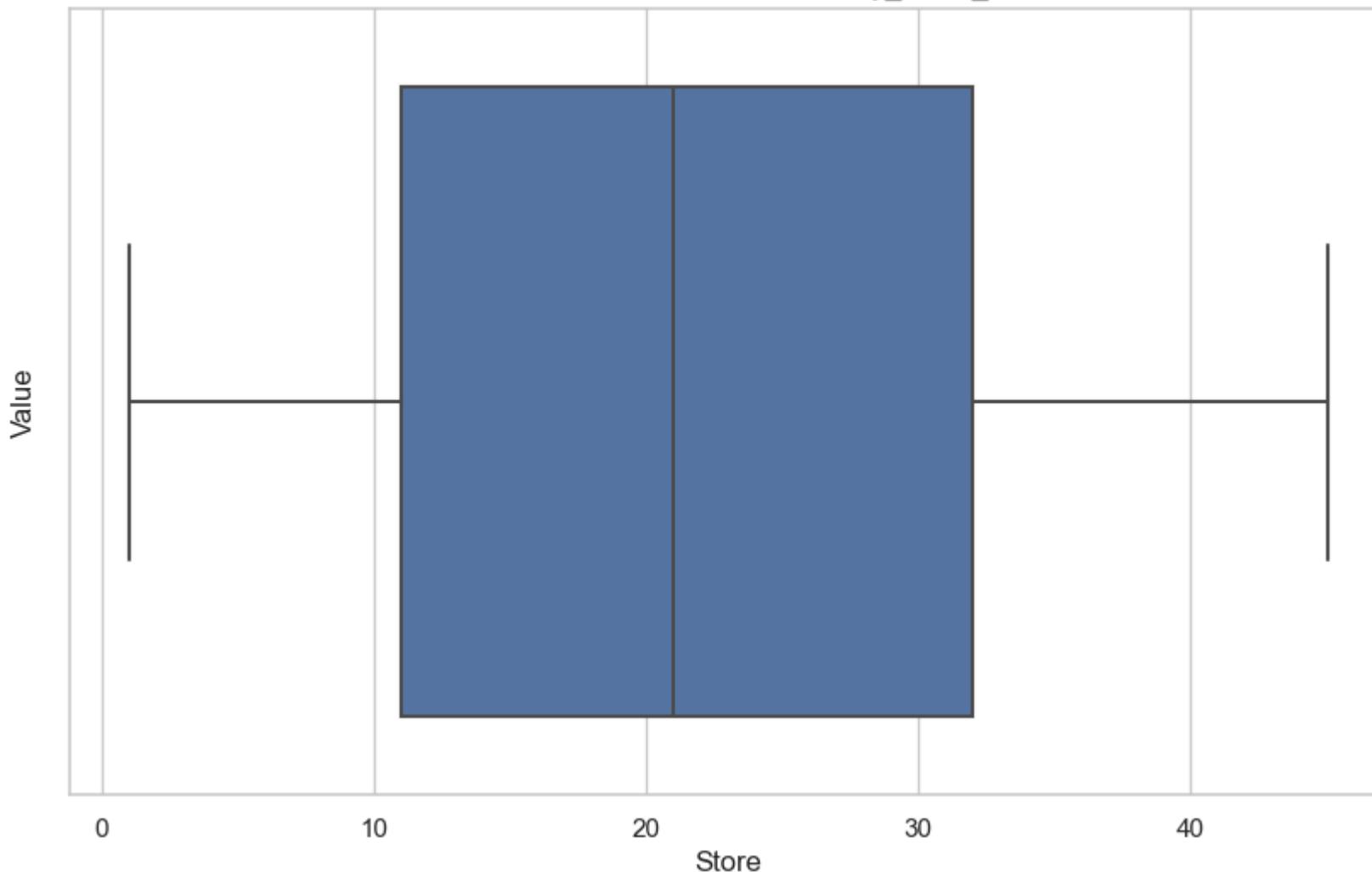


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_12w

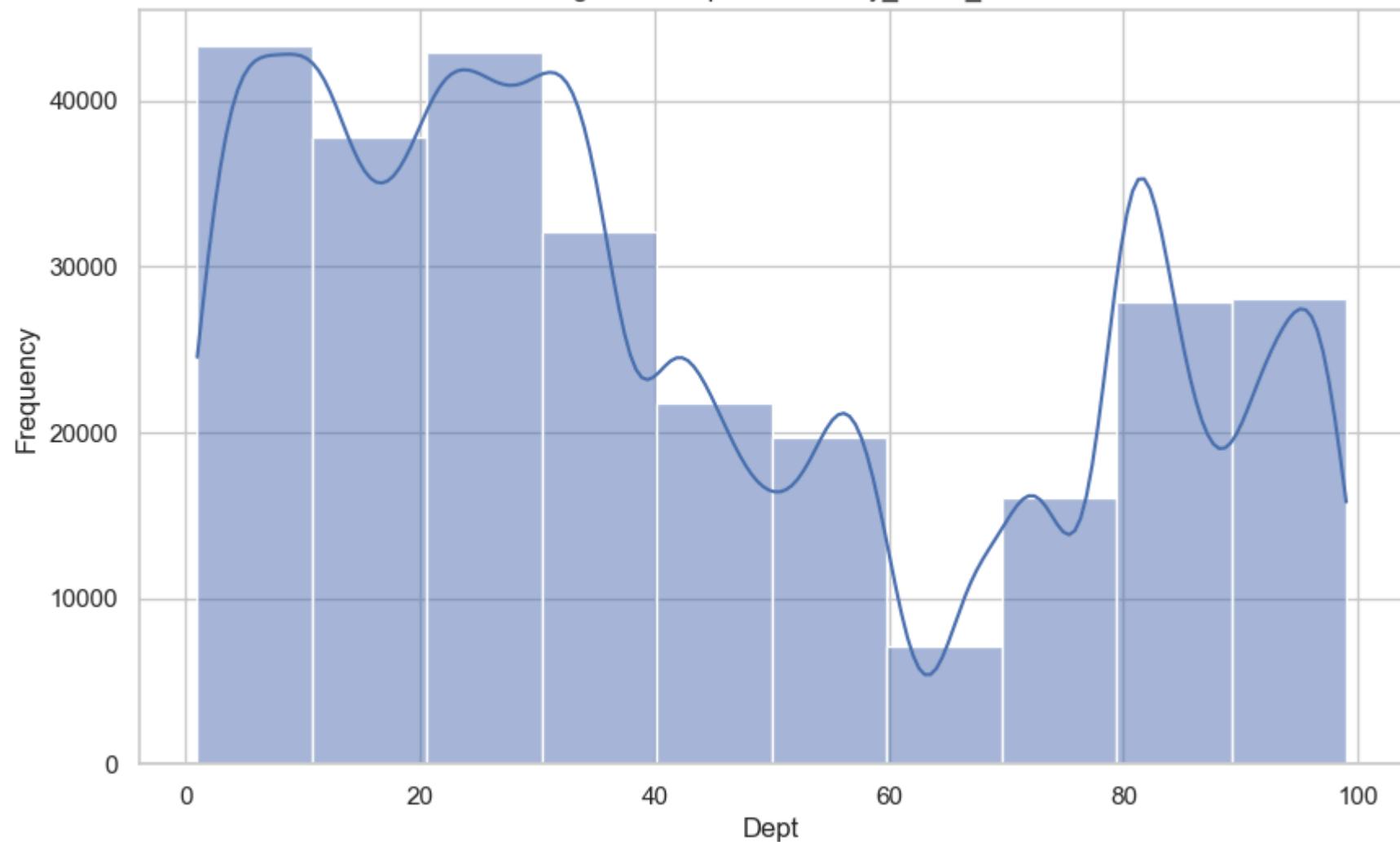


Box Plot of Store in Data with Weekly_Sales_12w

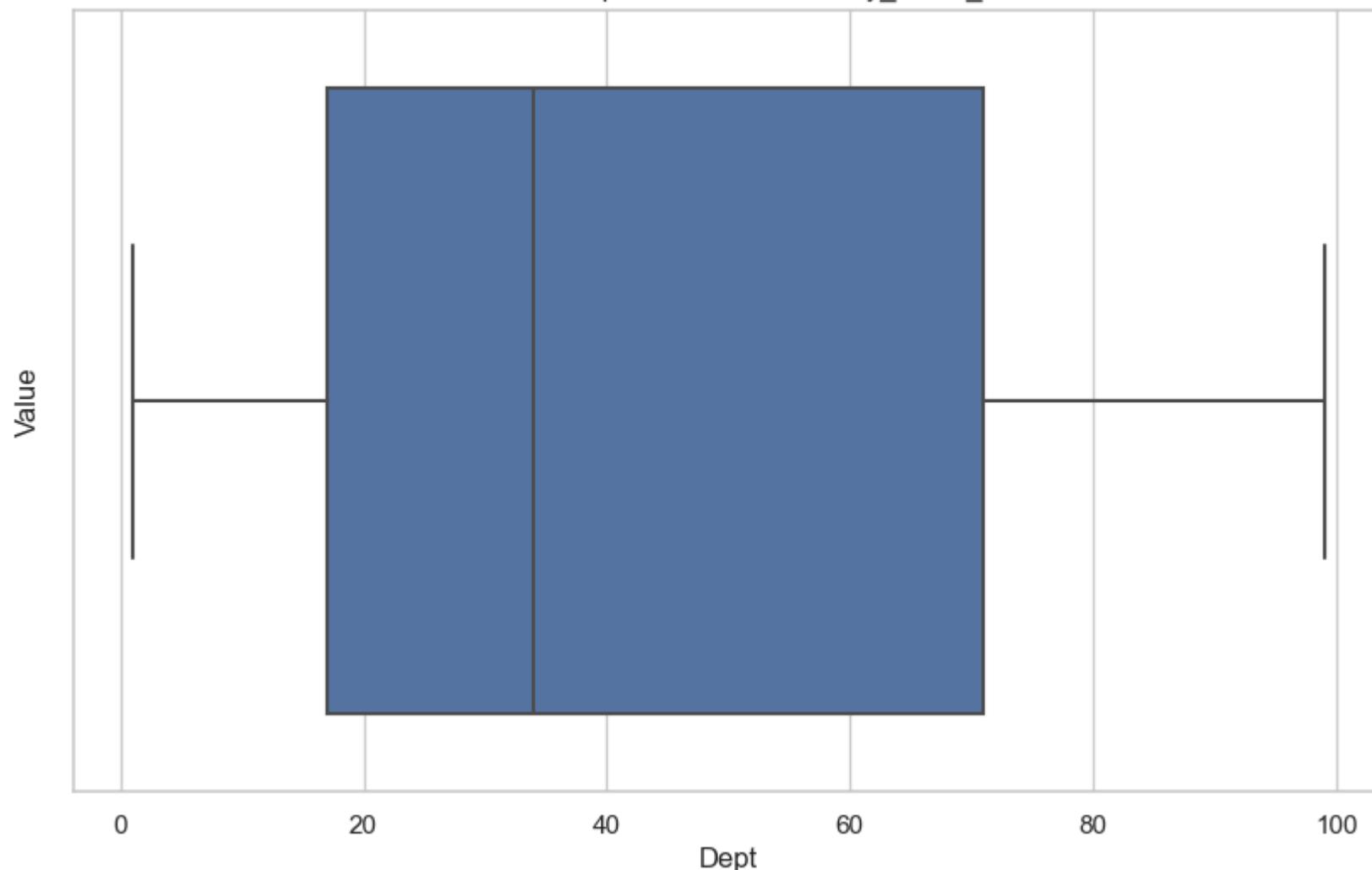


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

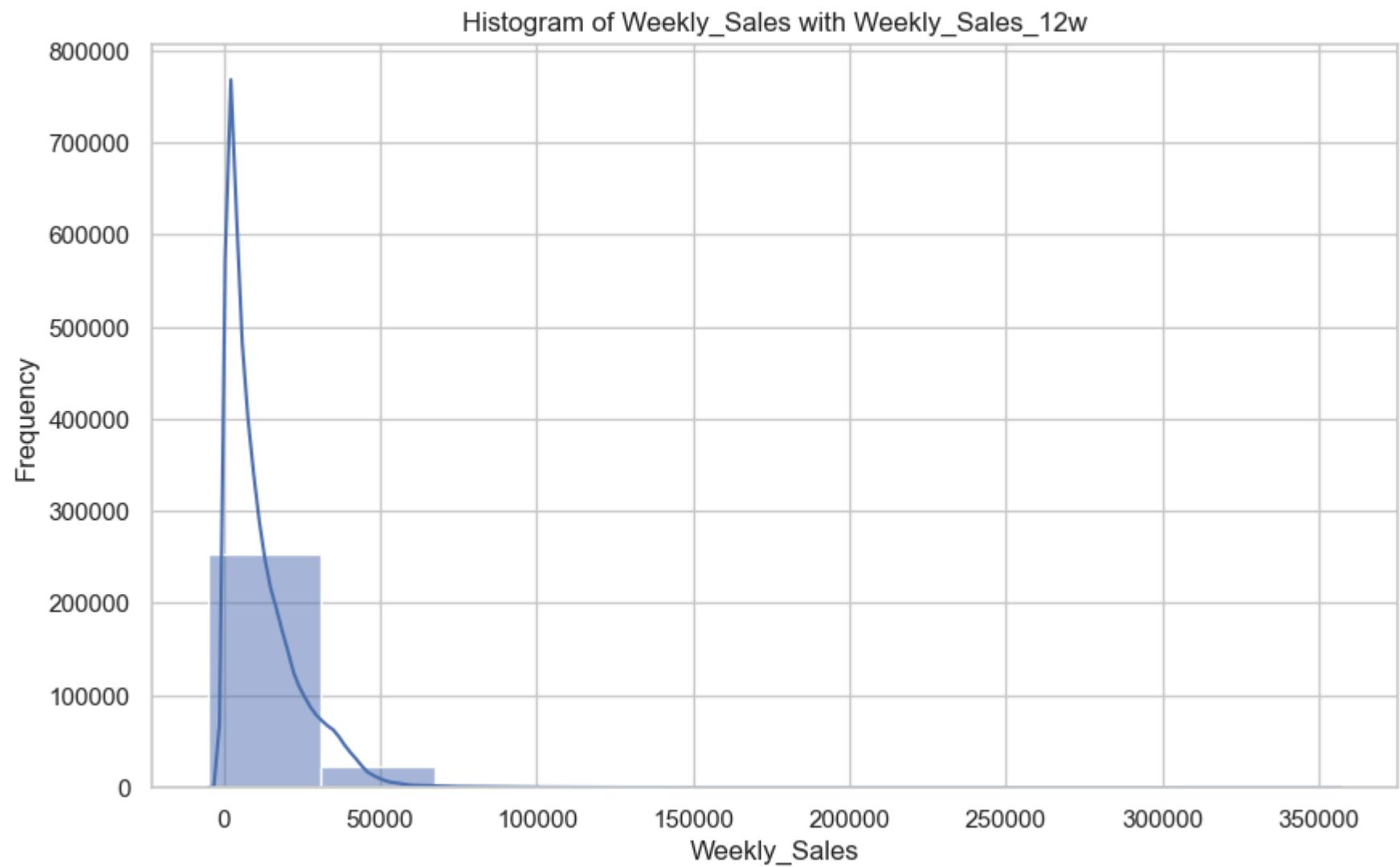
Histogram of Dept with Weekly_Sales_12w



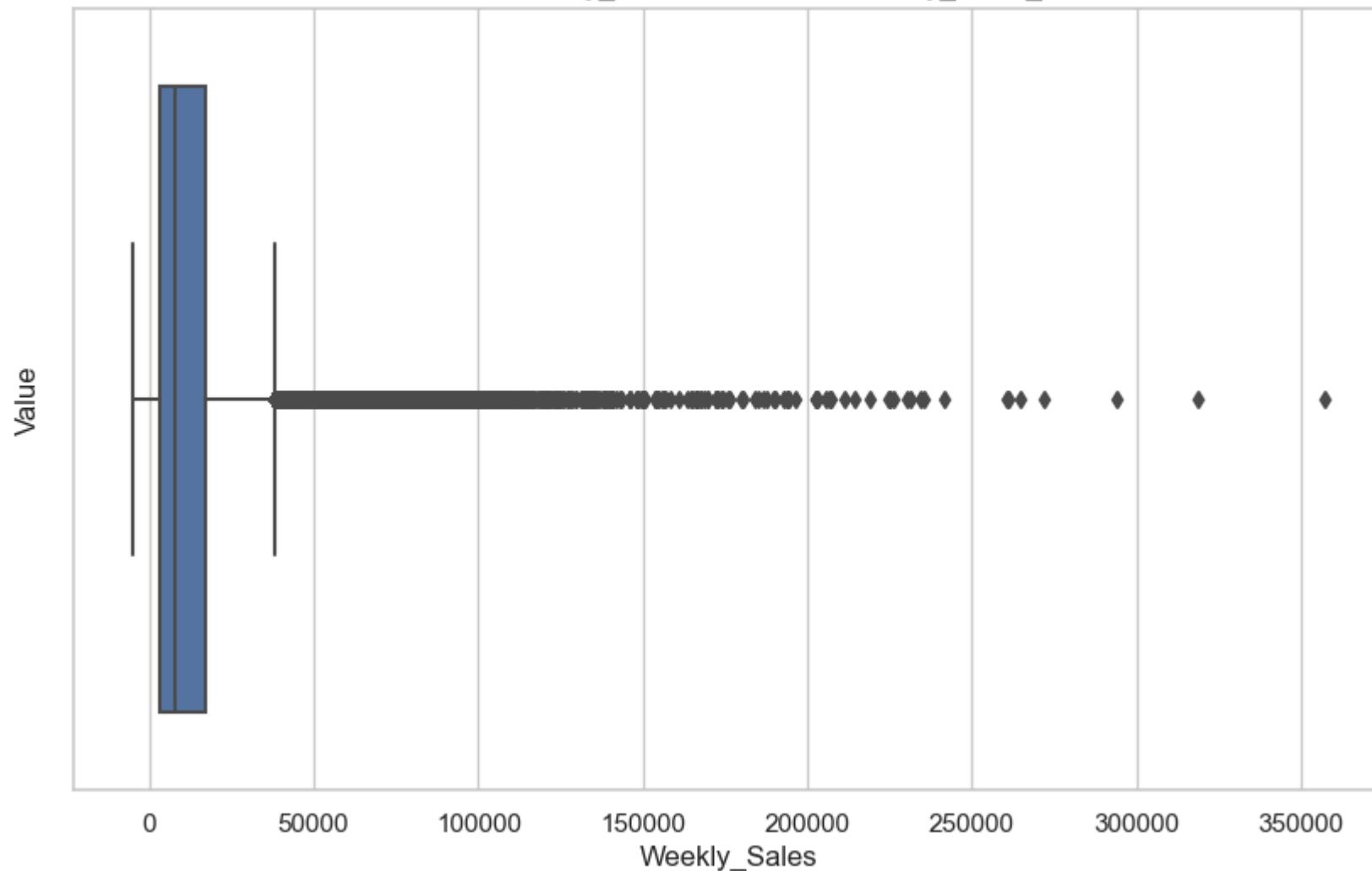
Box Plot of Dept in Data with Weekly_Sales_12w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

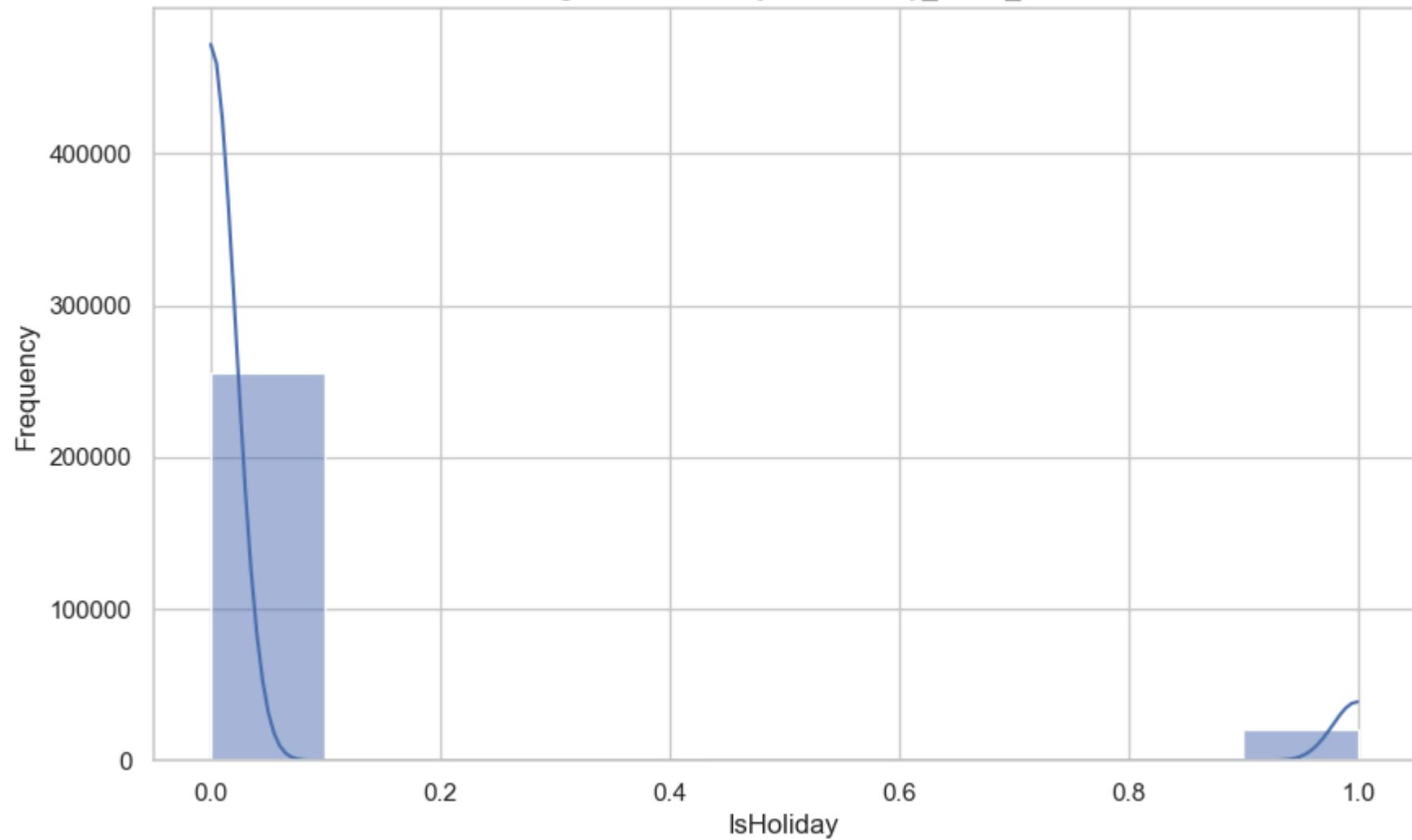


Box Plot of Weekly_Sales in Data with Weekly_Sales_12w

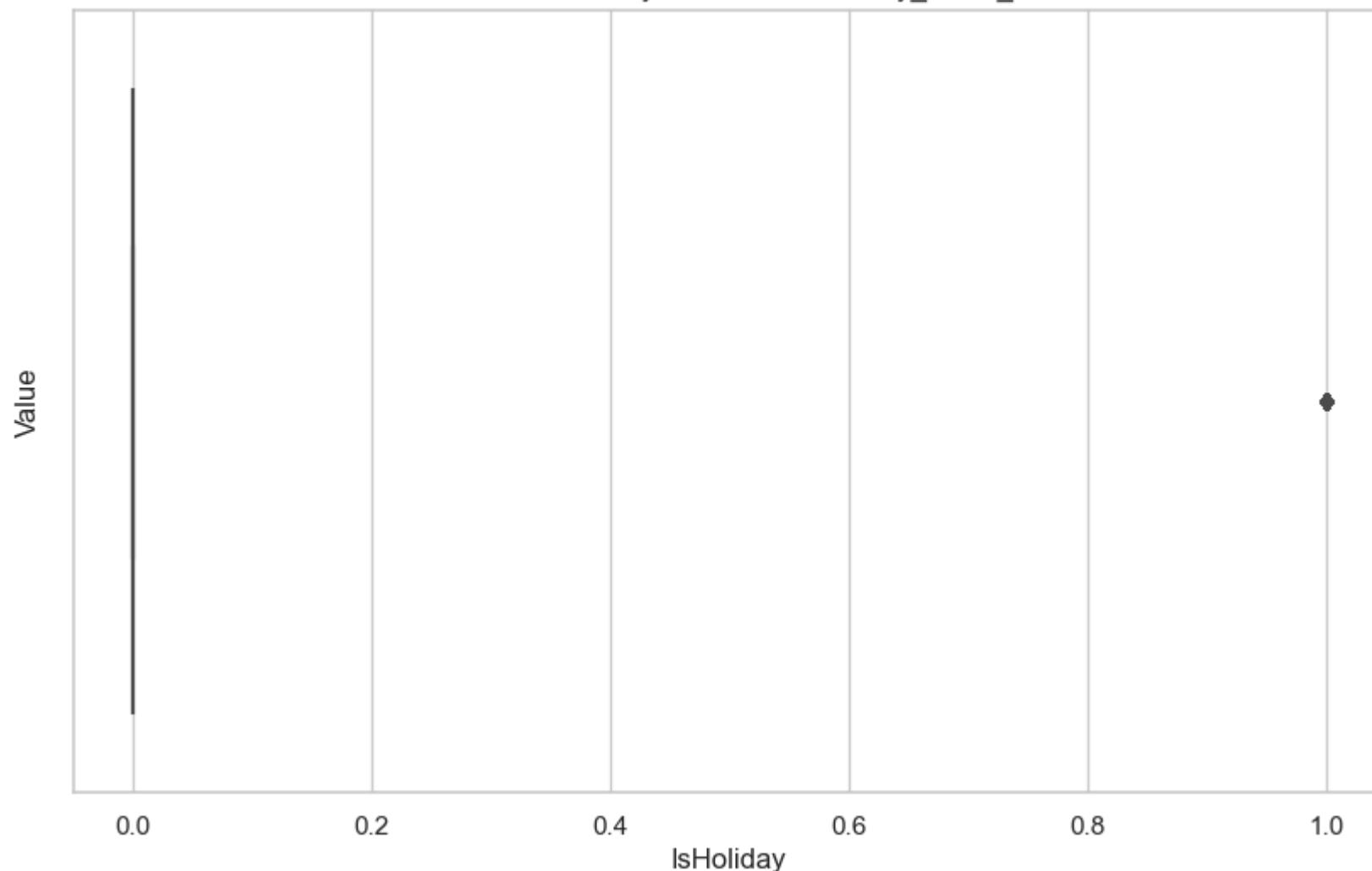


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_12w

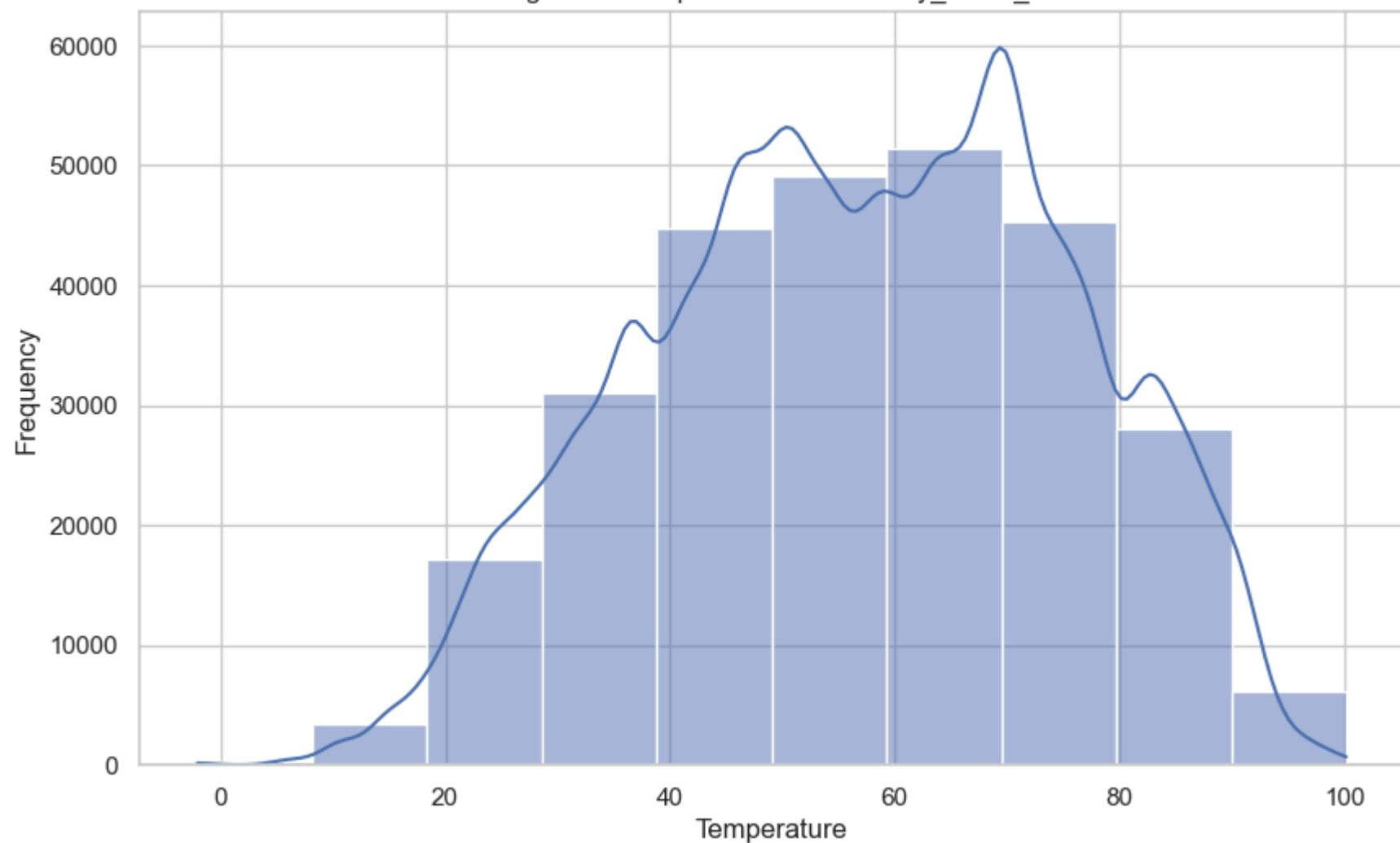


Box Plot of IsHoliday in Data with Weekly_Sales_12w

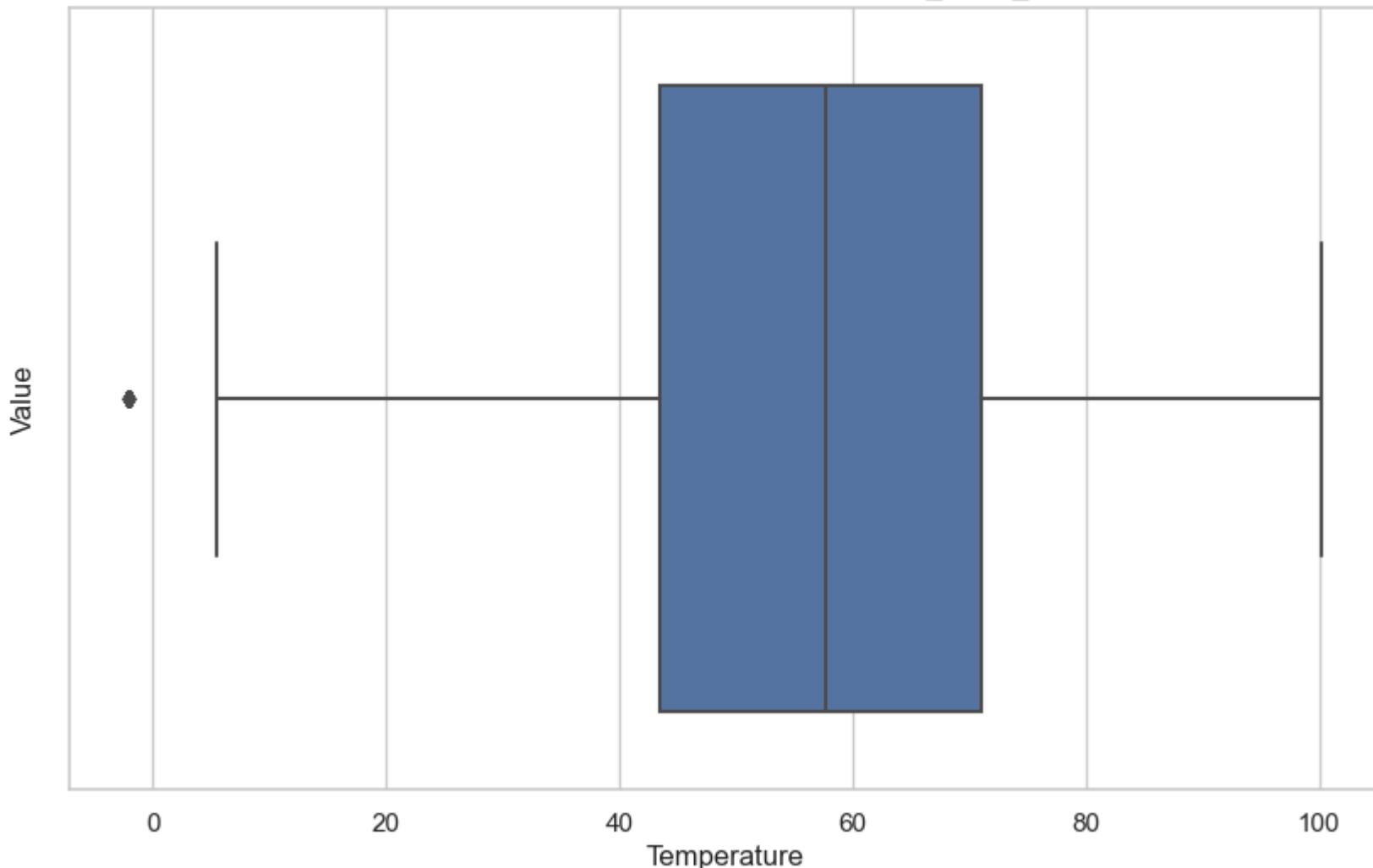


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_12w

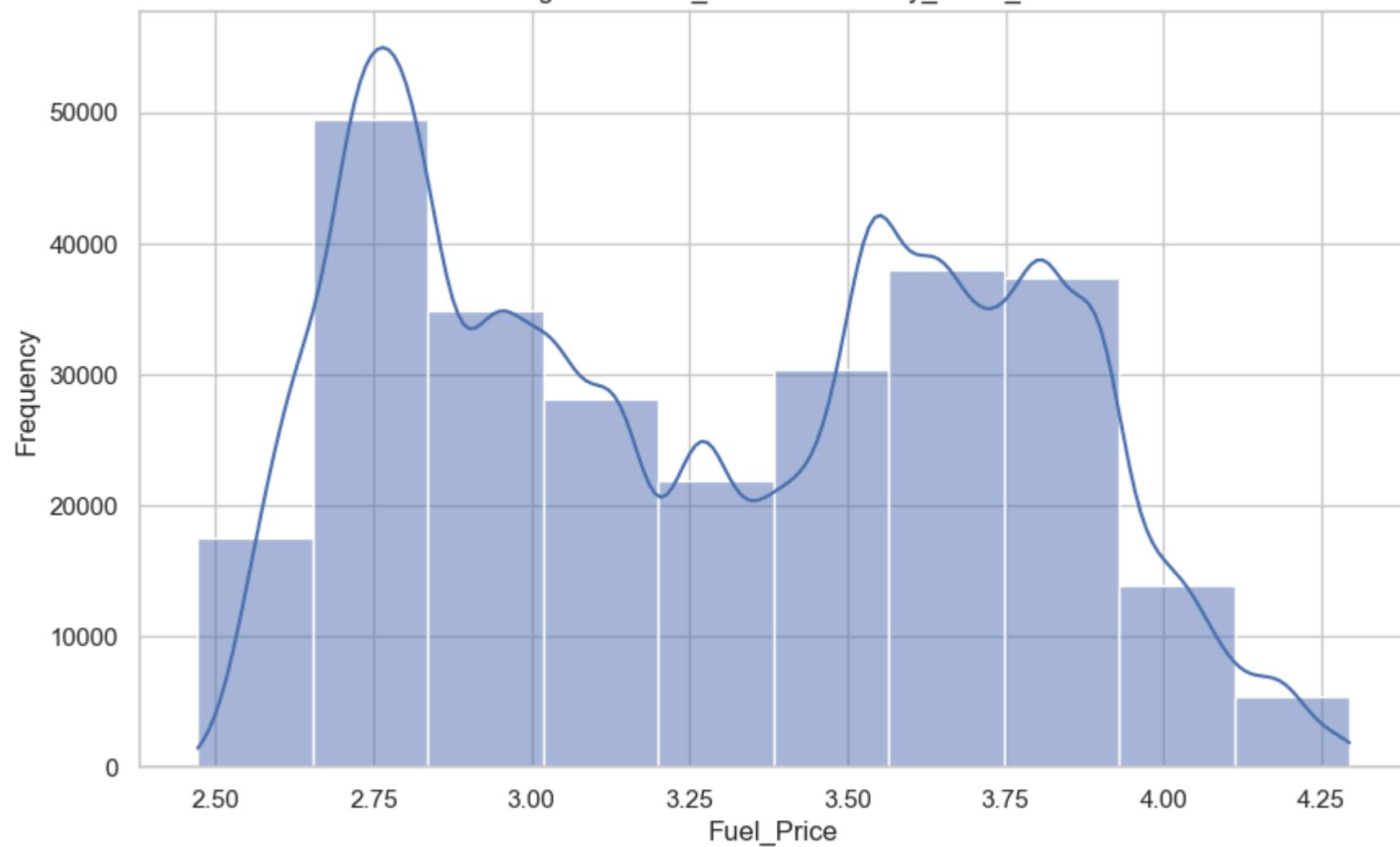


Box Plot of Temperature in Data with Weekly_Sales_12w

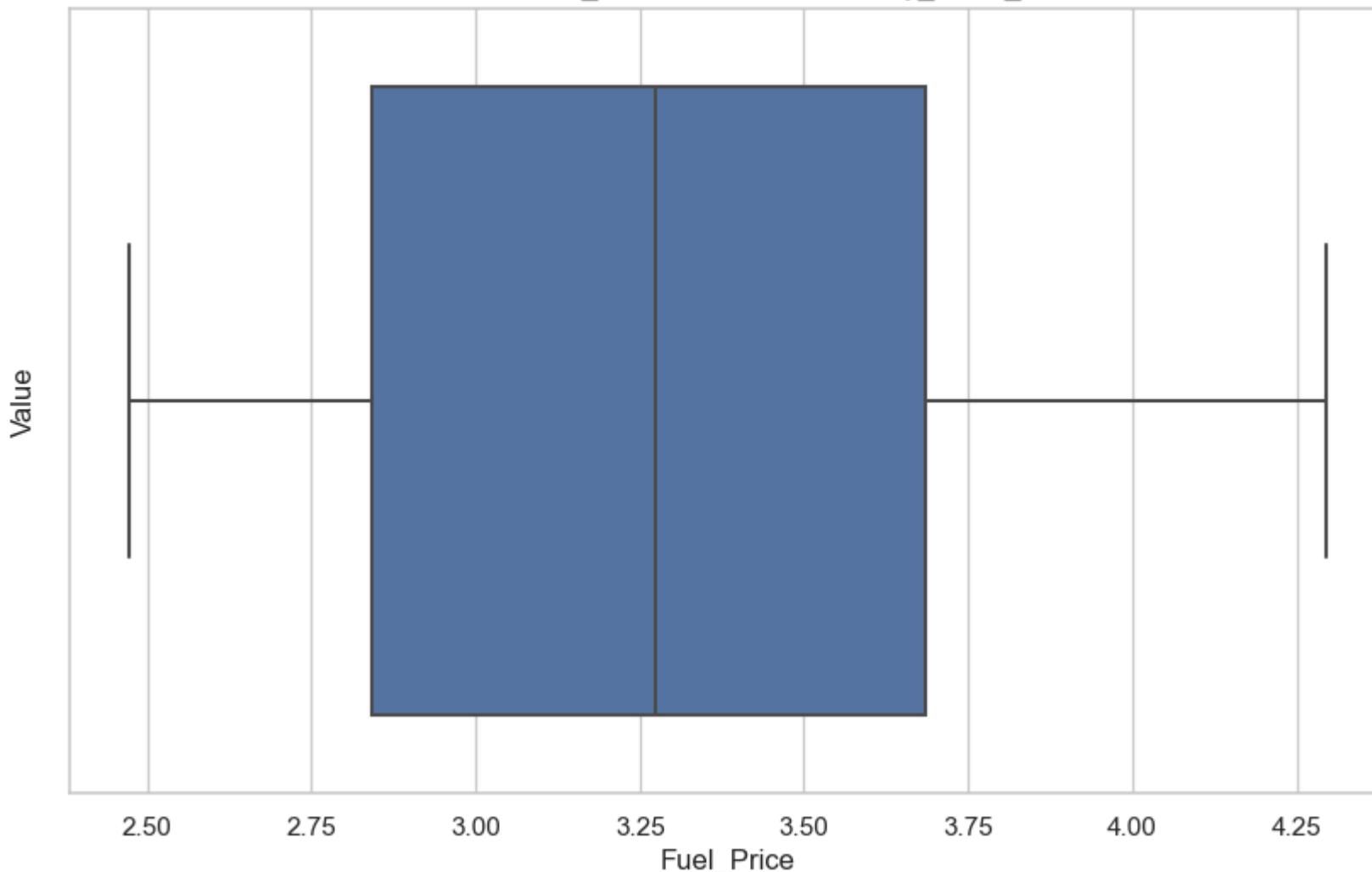


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

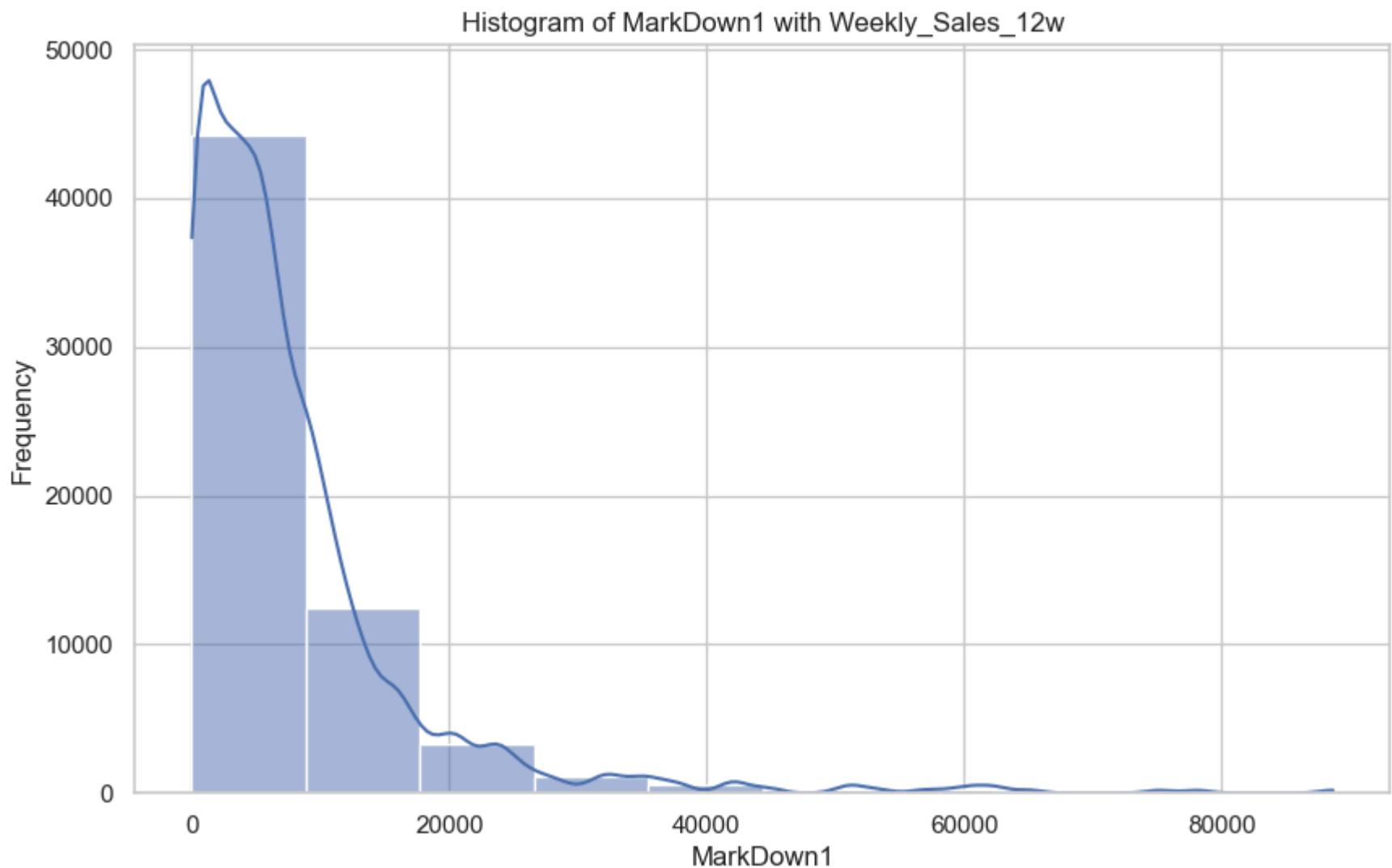
Histogram of Fuel_Price with Weekly_Sales_12w



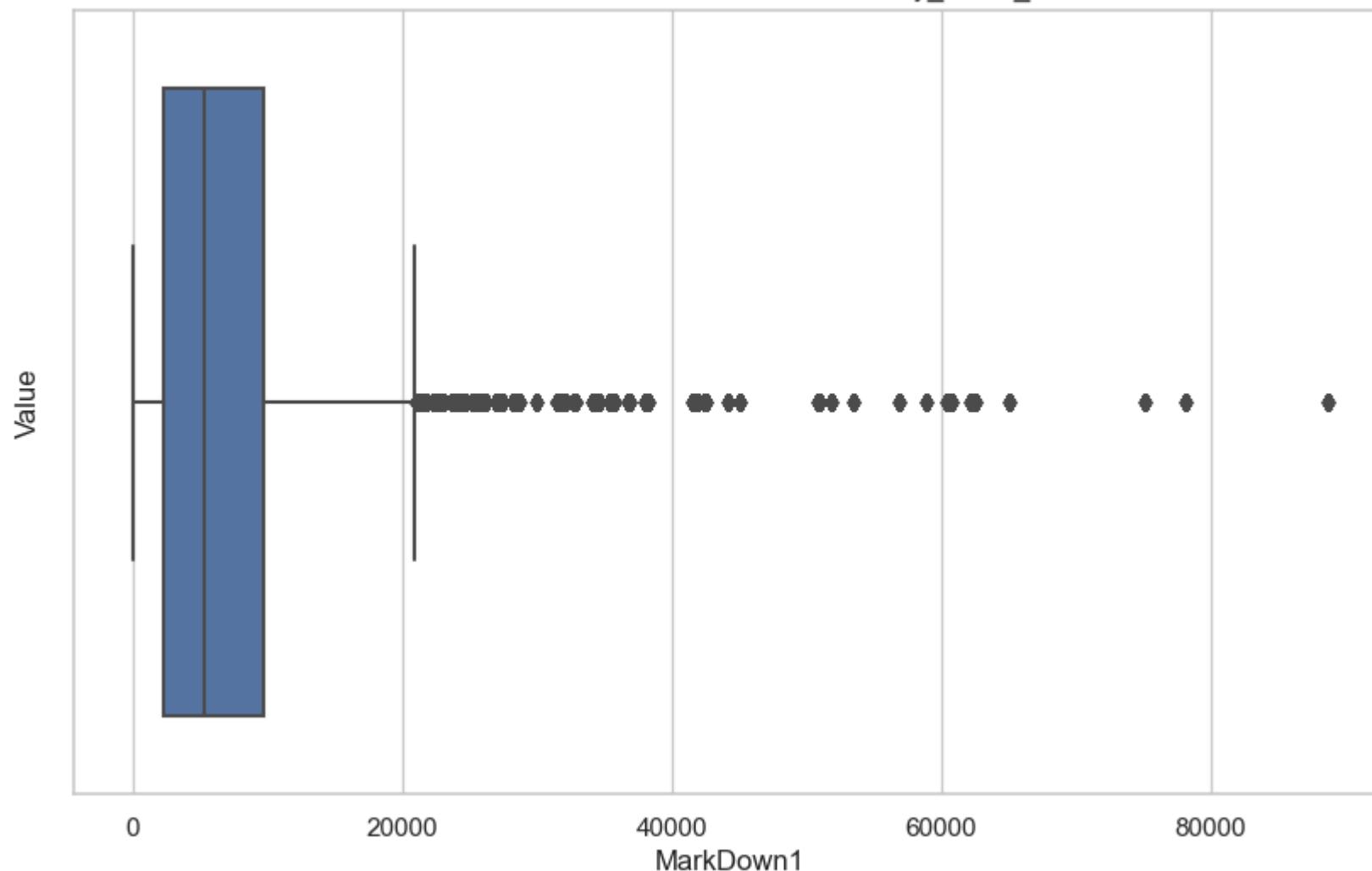
Box Plot of Fuel_Price in Data with Weekly_Sales_12w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

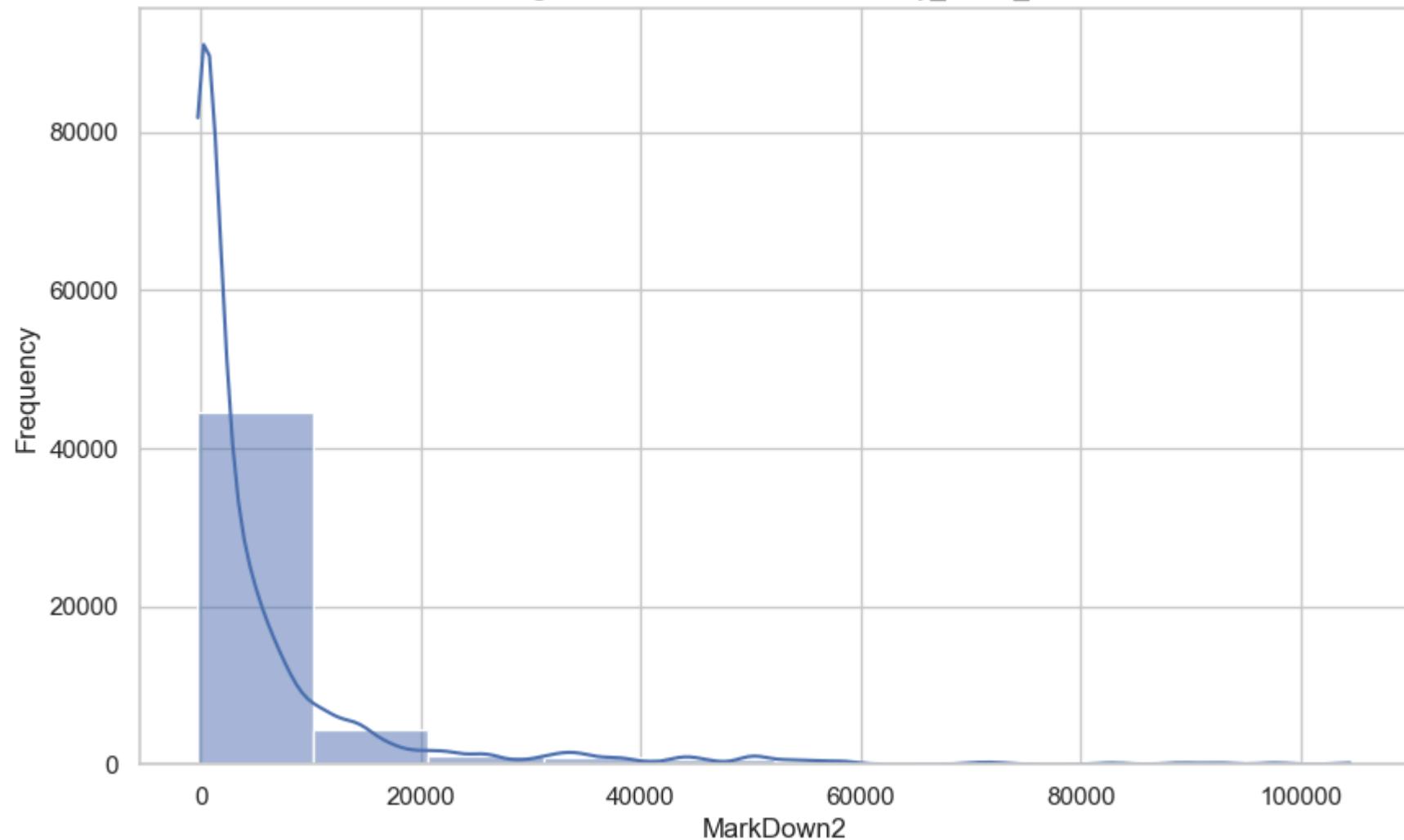


Box Plot of MarkDown1 in Data with Weekly_Sales_12w

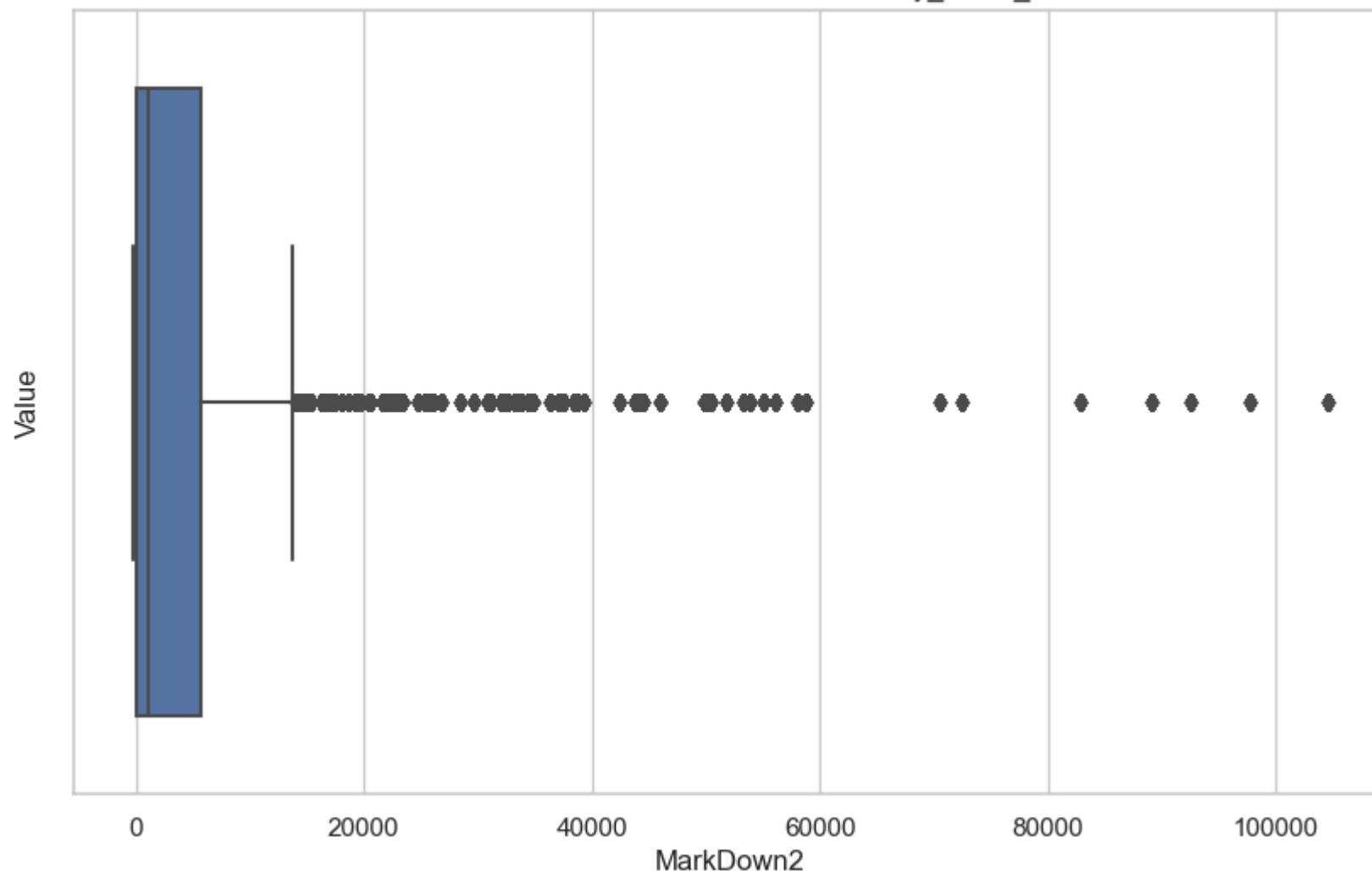


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_12w

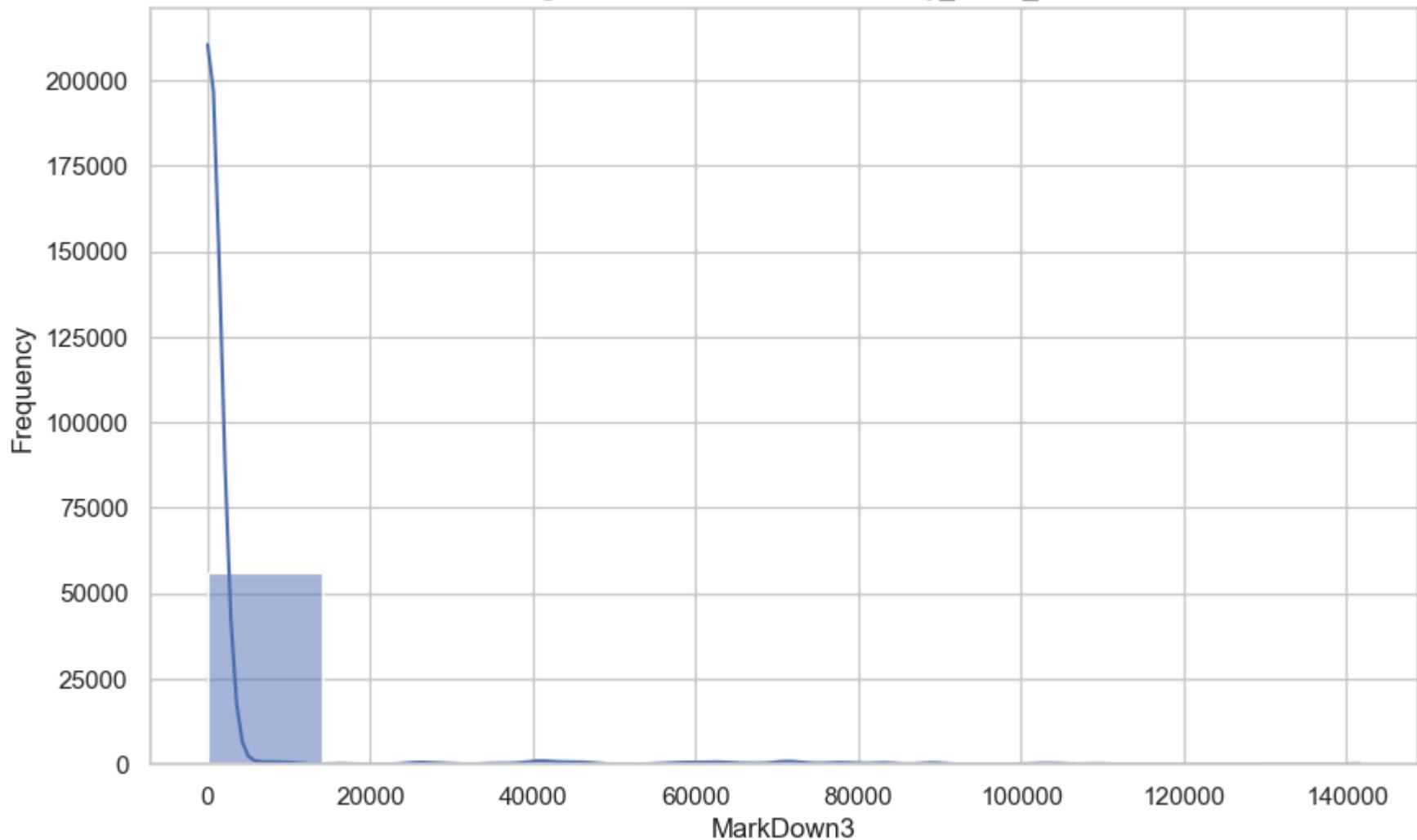


Box Plot of MarkDown2 in Data with Weekly_Sales_12w

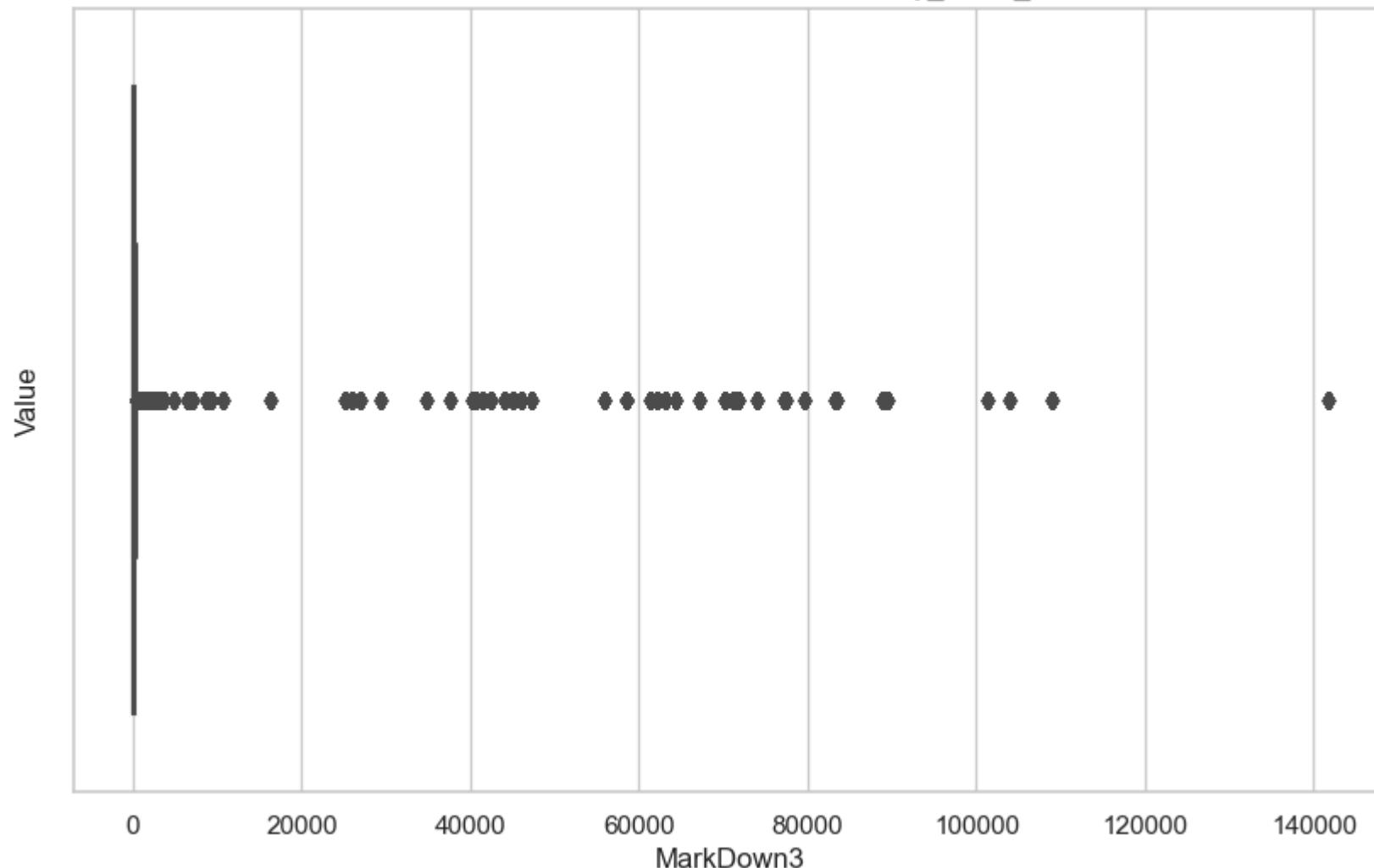


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_12w

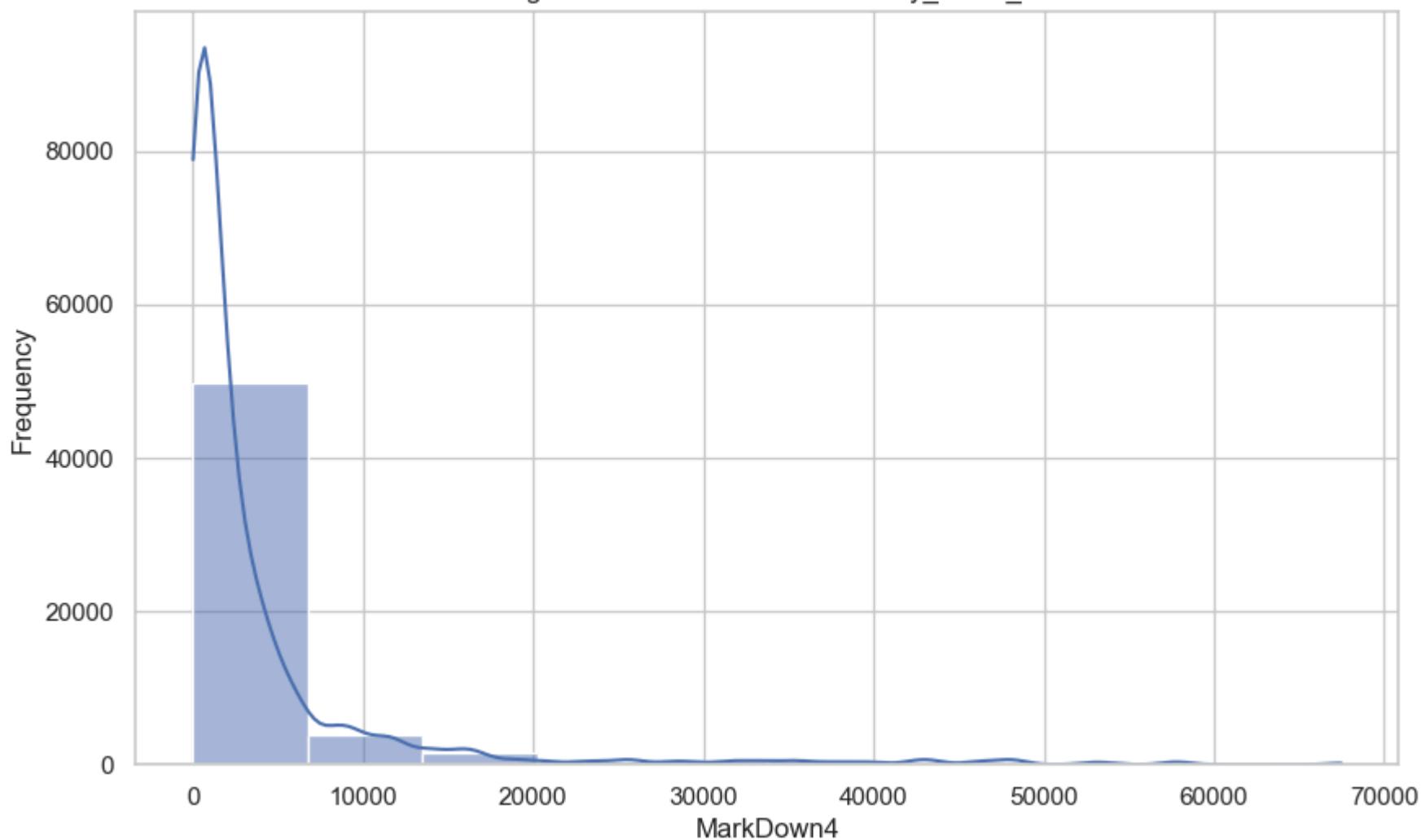


Box Plot of MarkDown3 in Data with Weekly_Sales_12w

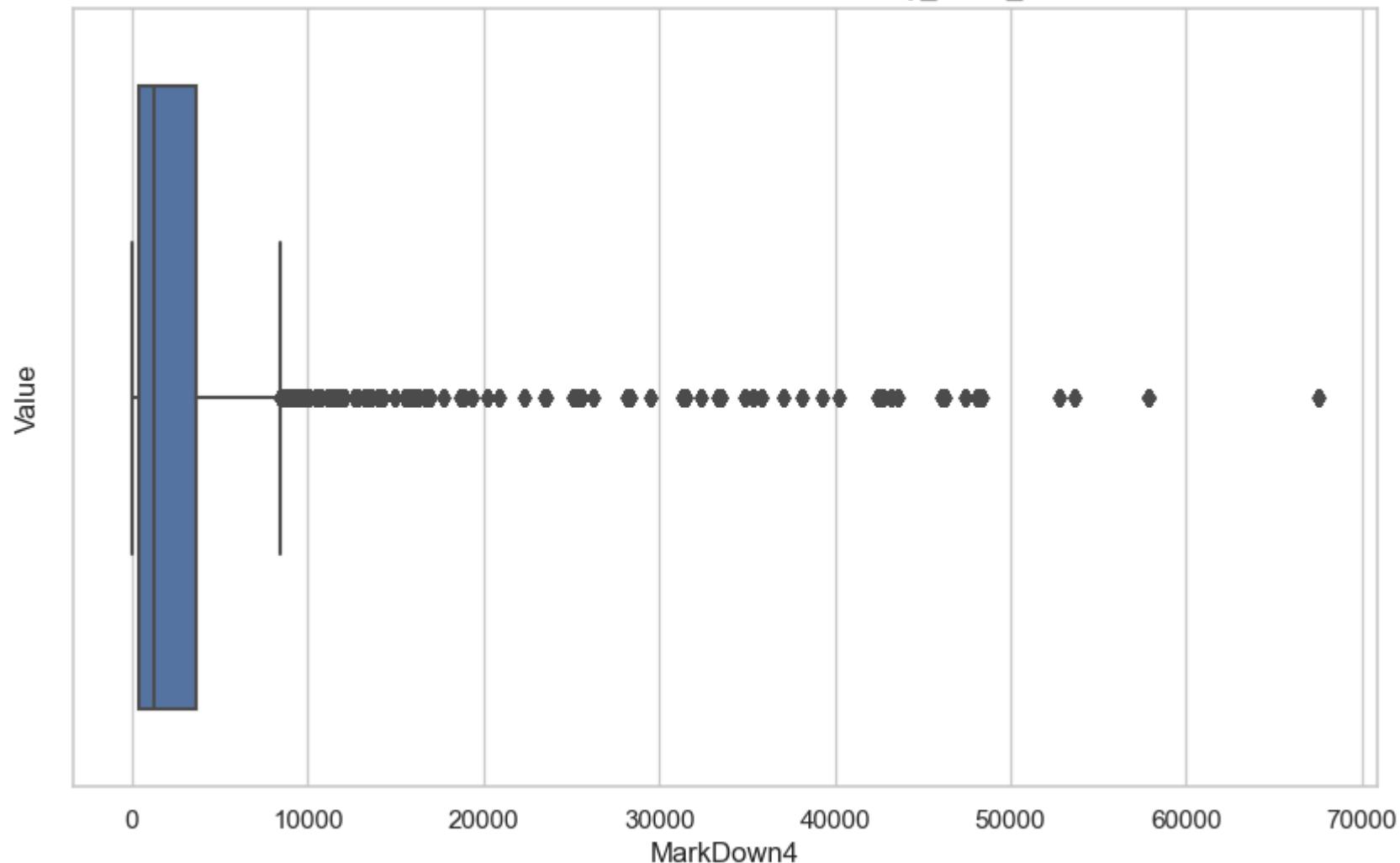


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_12w

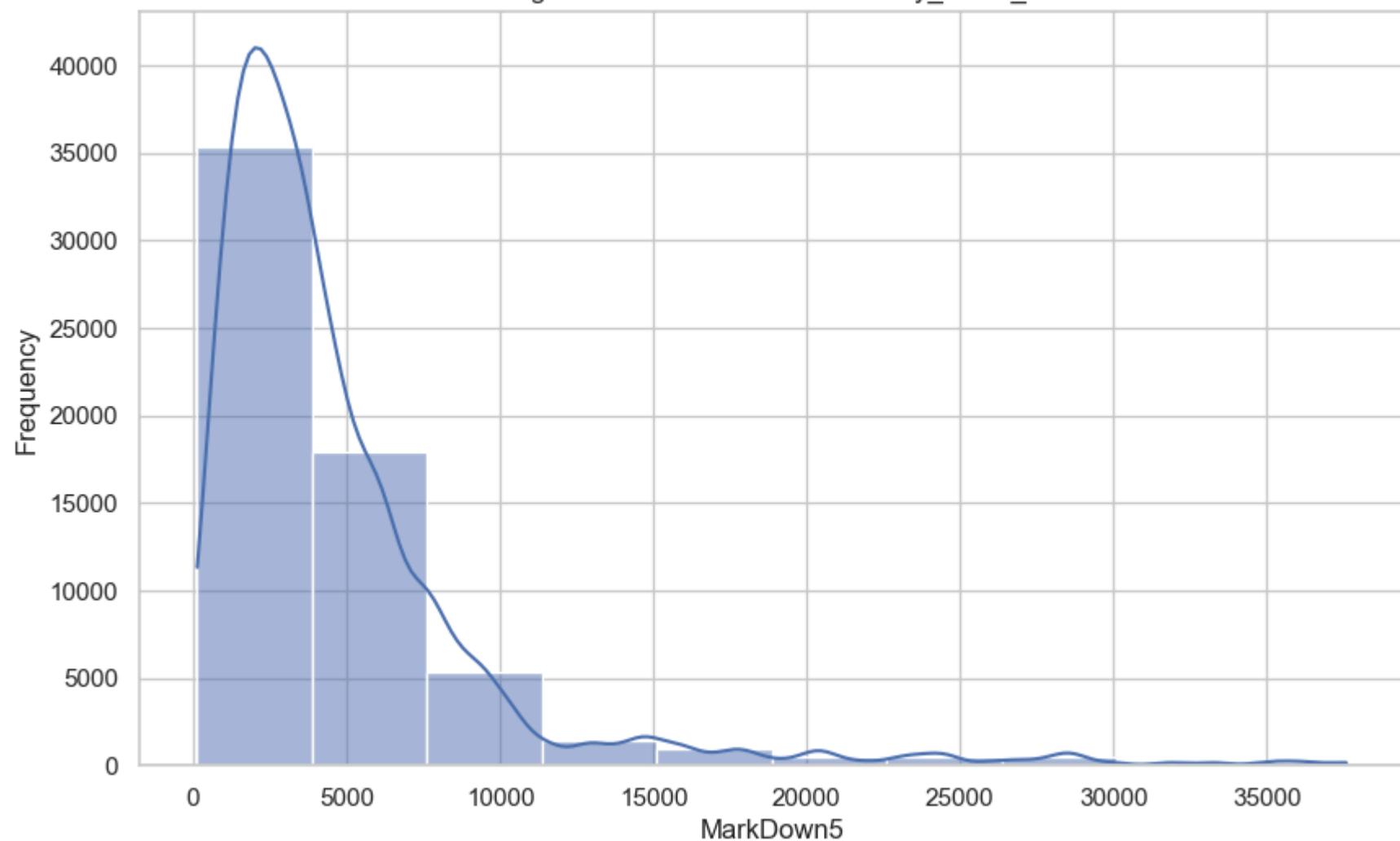


Box Plot of MarkDown4 in Data with Weekly_Sales_12w

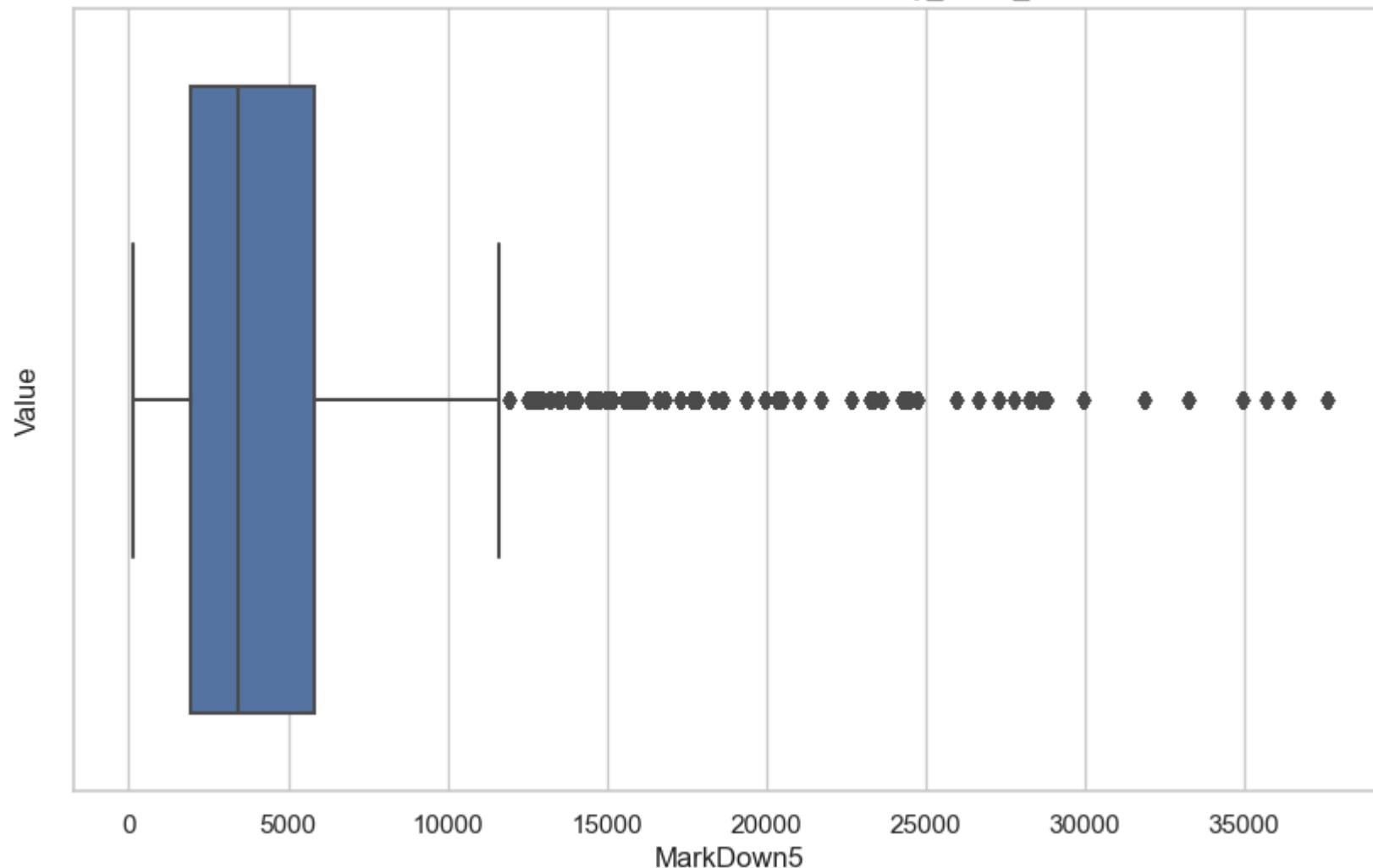


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_12w

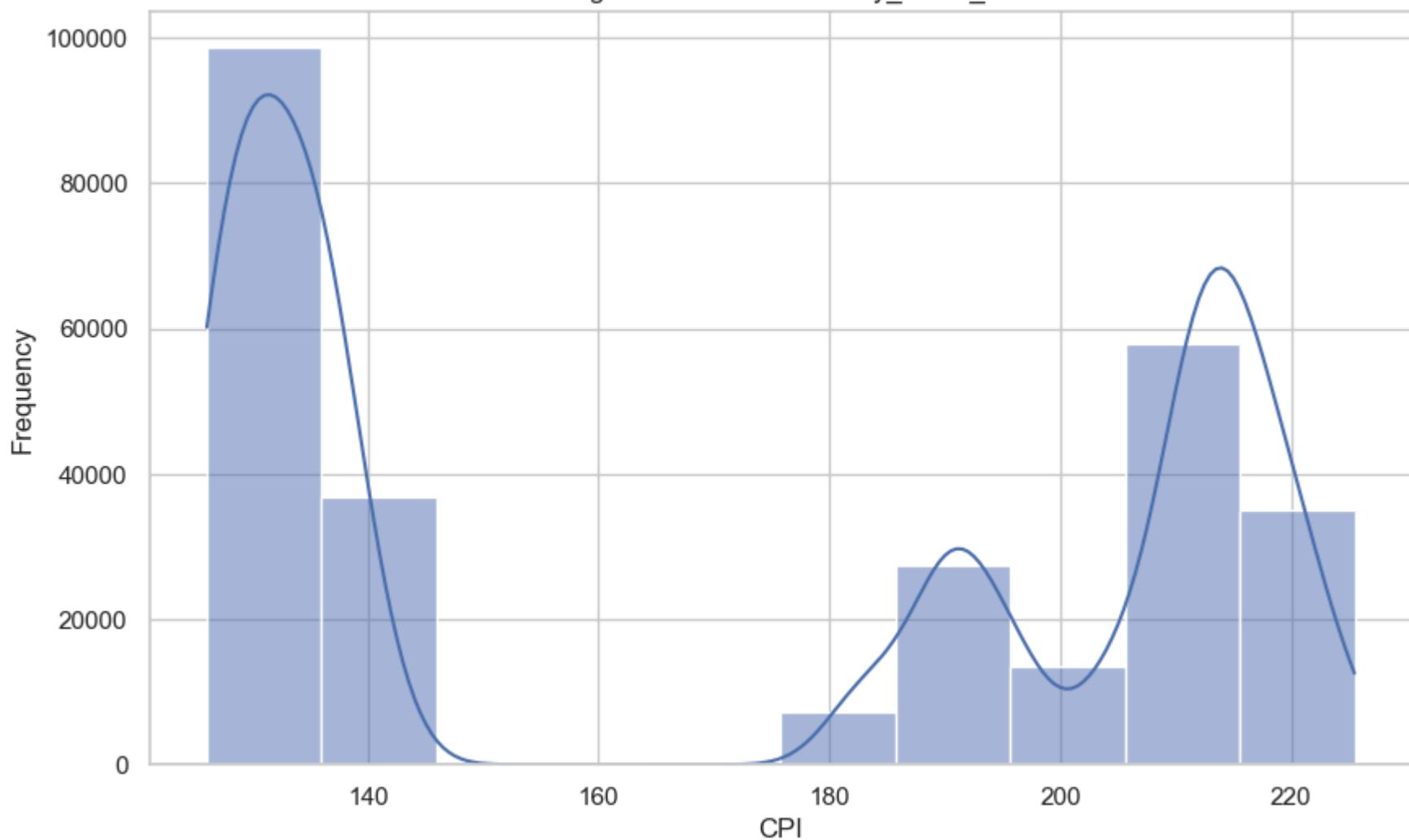


Box Plot of MarkDown5 in Data with Weekly_Sales_12w

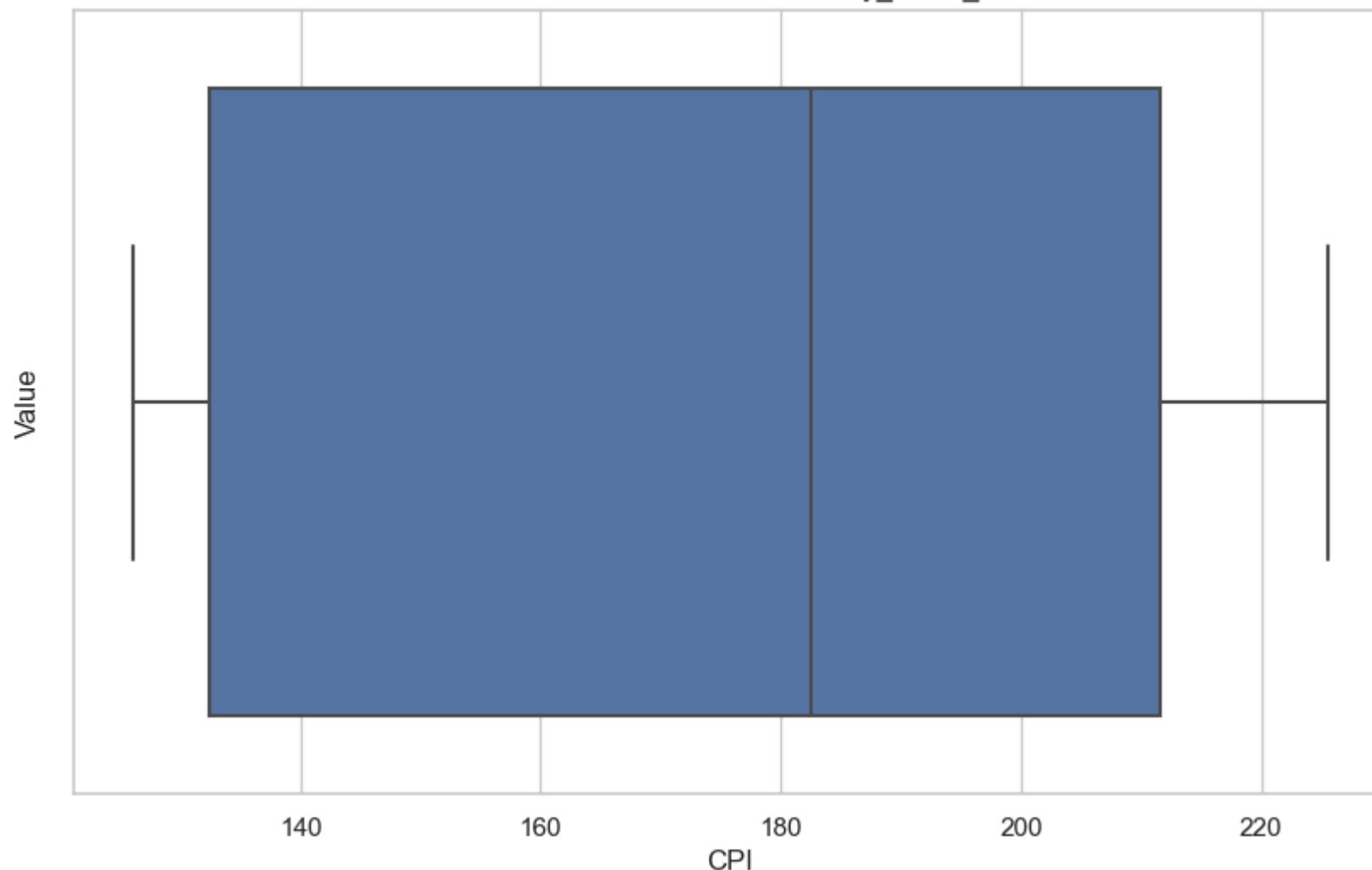


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_12w

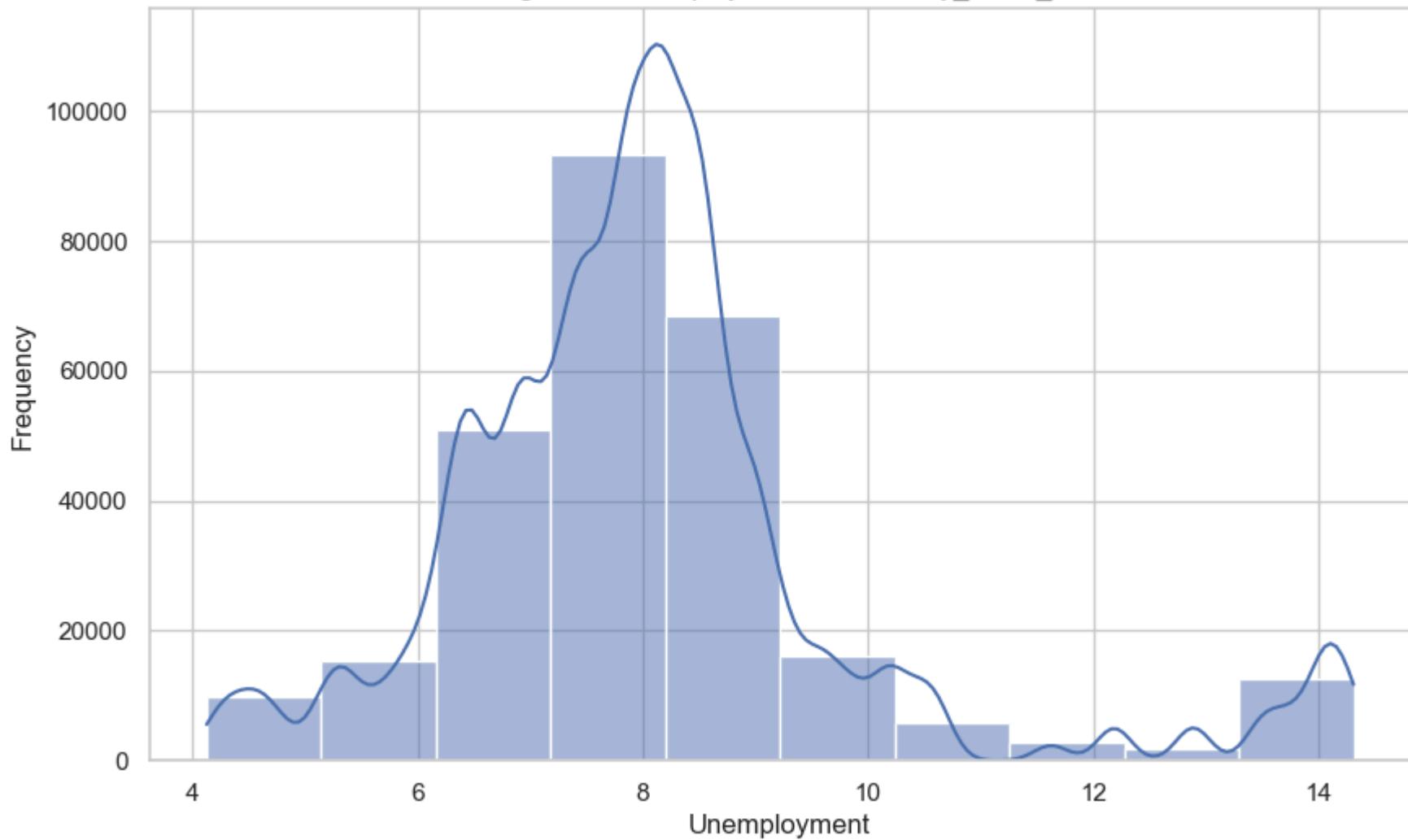


Box Plot of CPI in Data with Weekly_Sales_12w

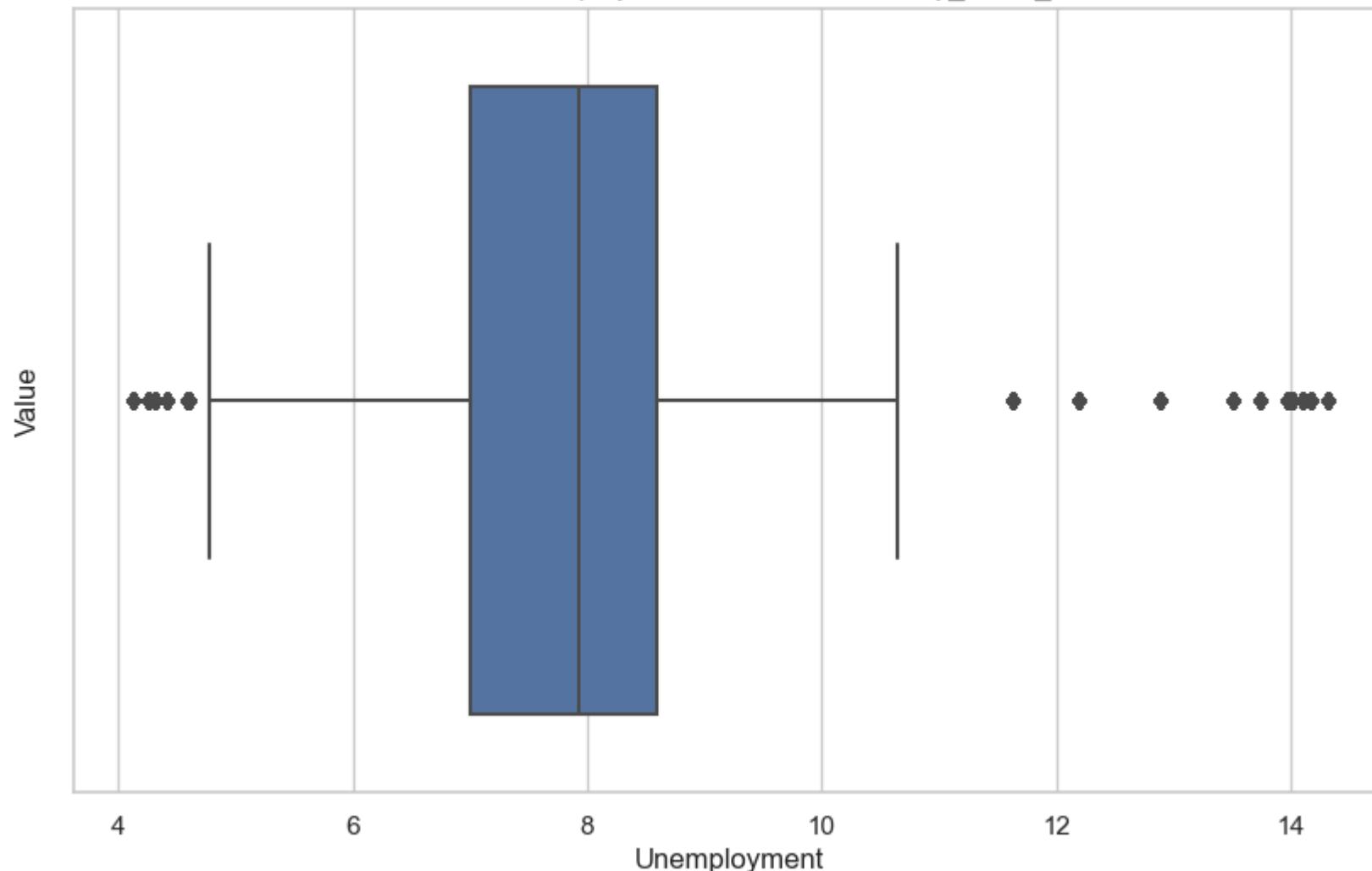


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_12w

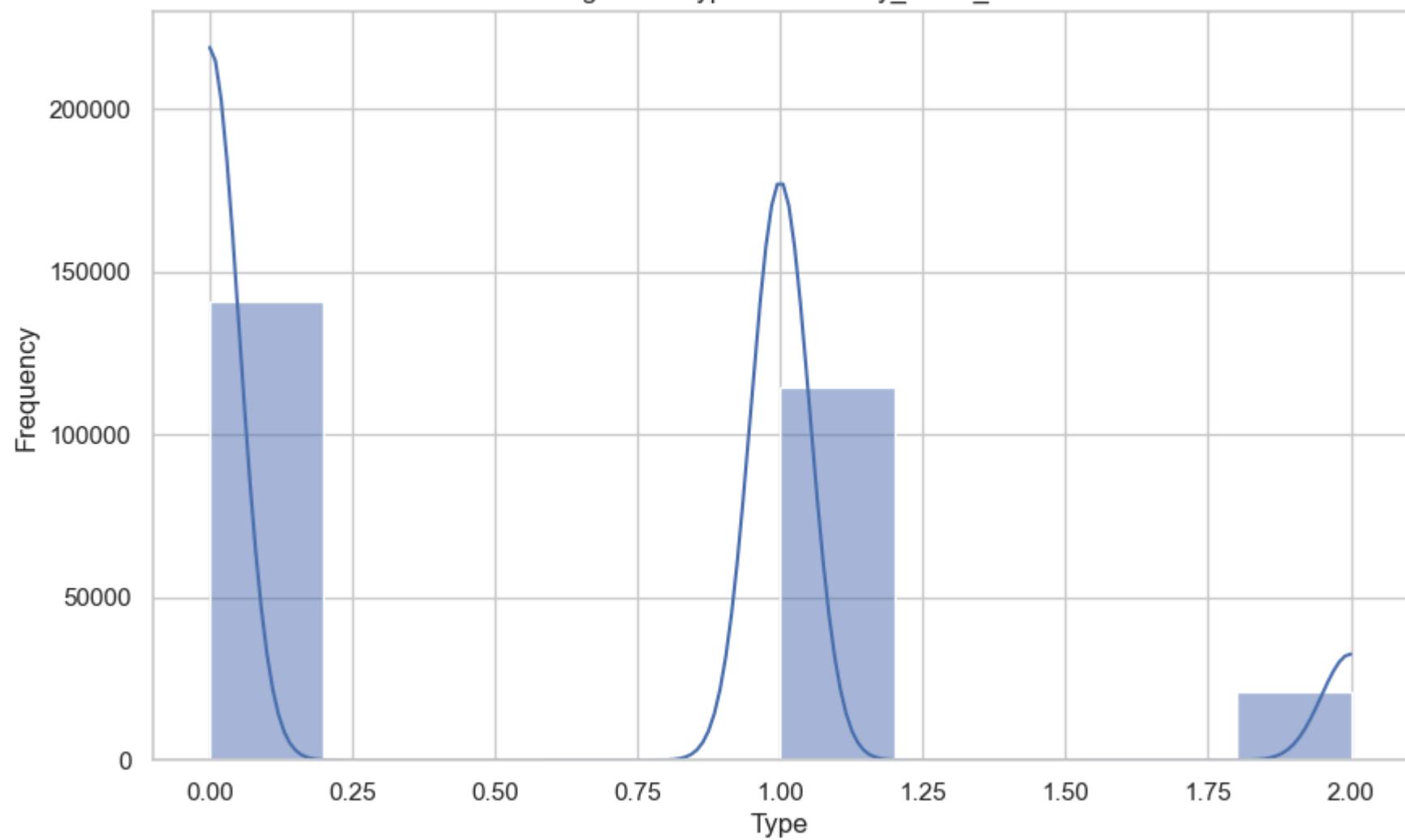


Box Plot of Unemployment in Data with Weekly_Sales_12w

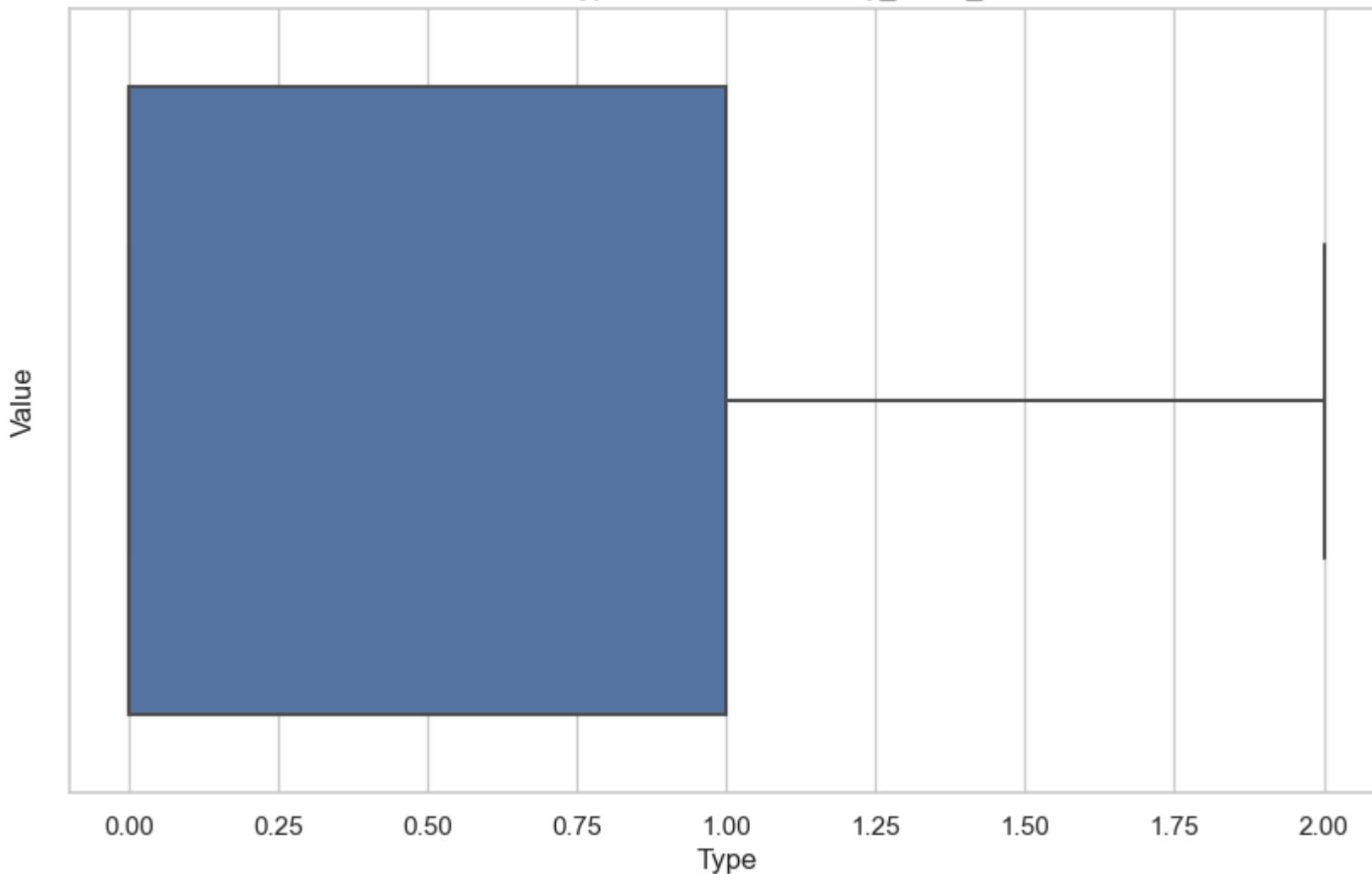


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

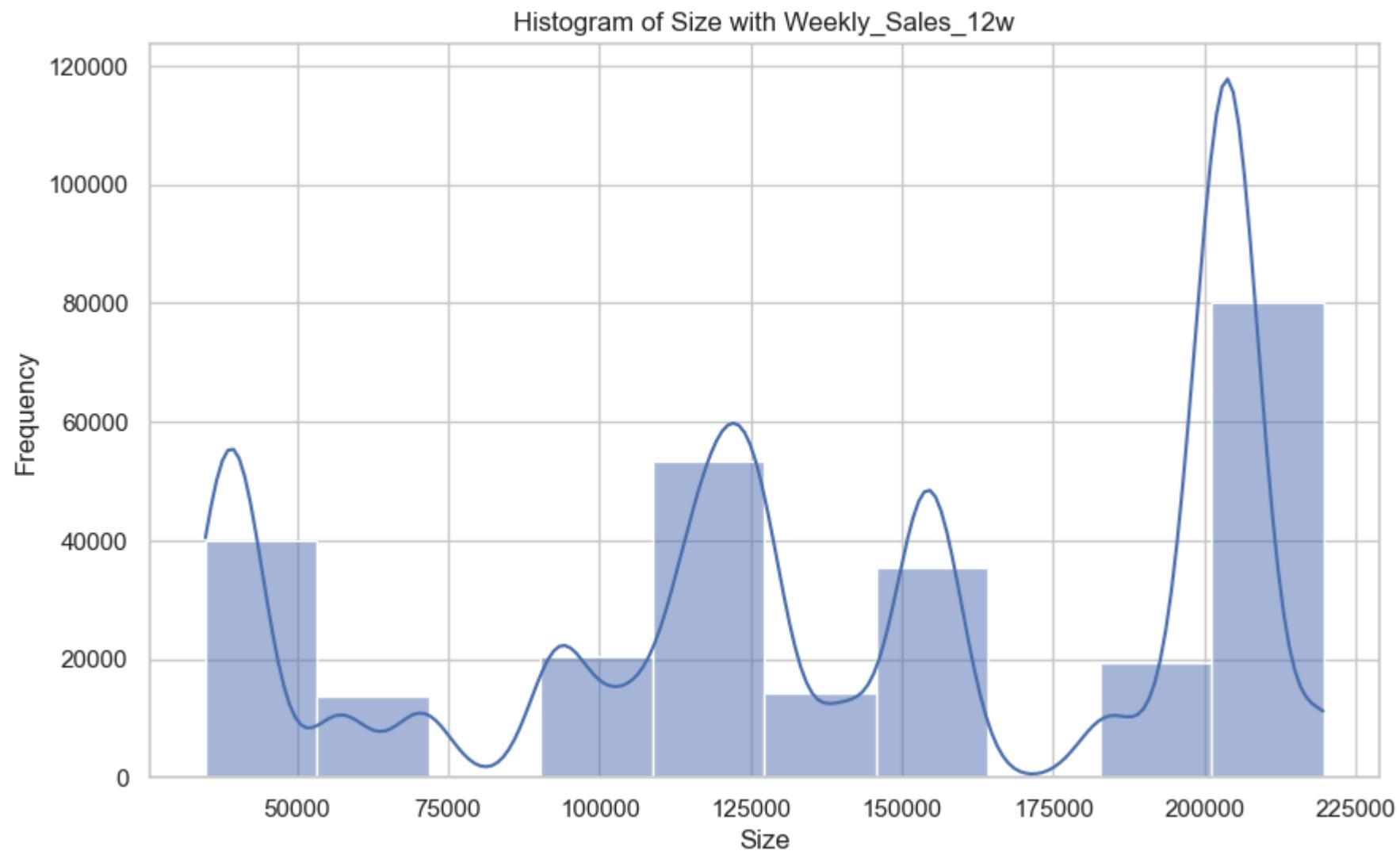
Histogram of Type with Weekly_Sales_12w



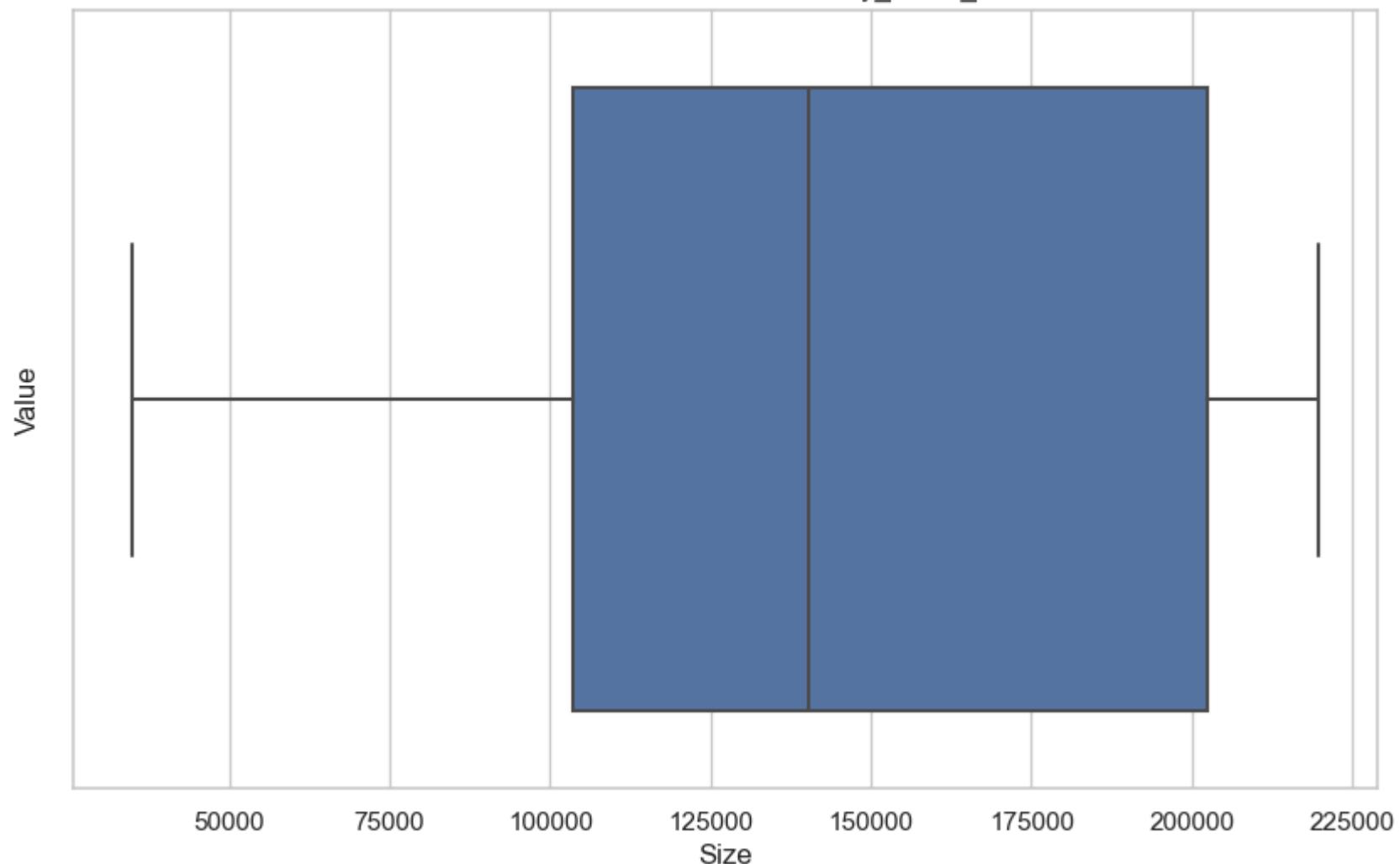
Box Plot of Type in Data with Weekly_Sales_12w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

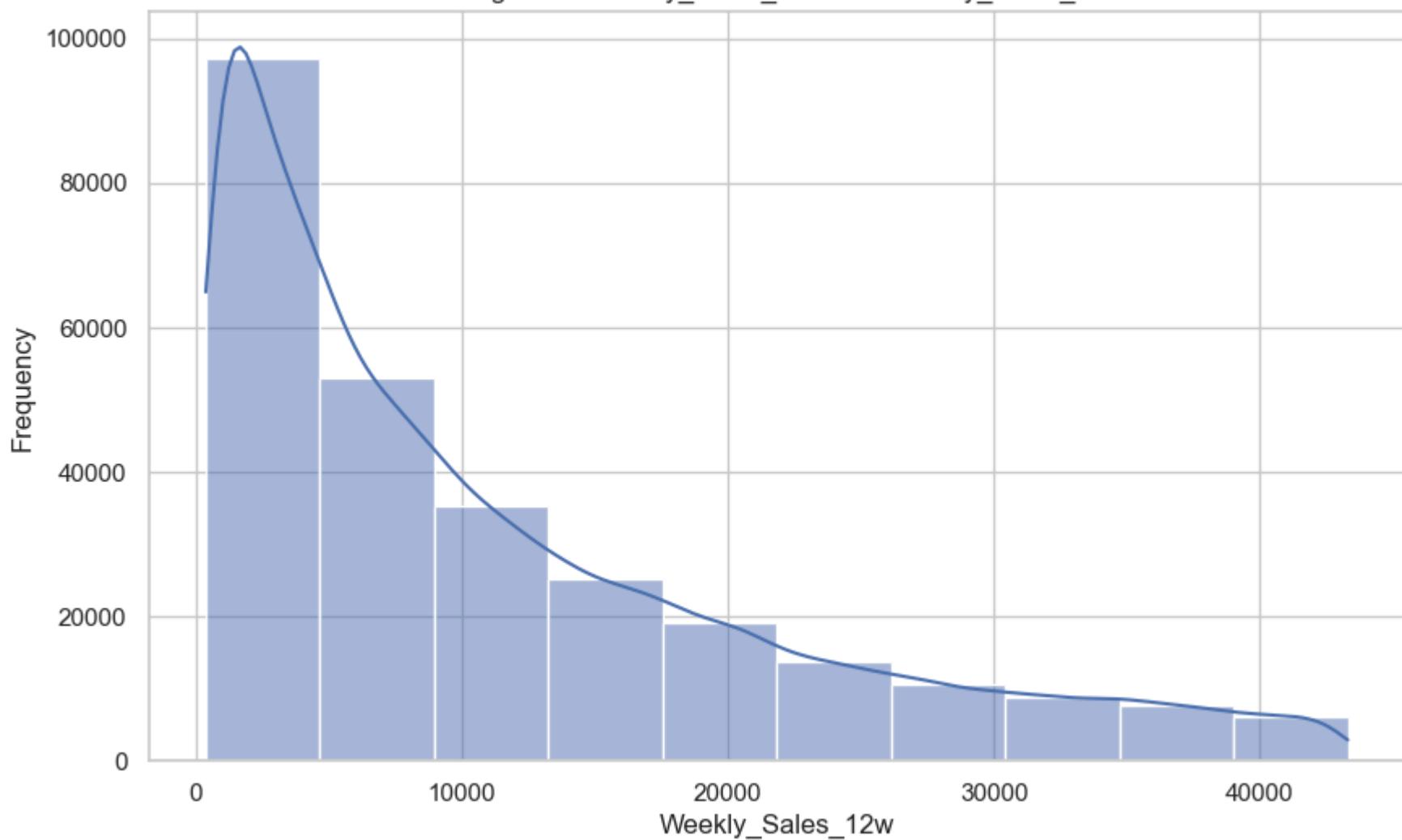


Box Plot of Size in Data with Weekly_Sales_12w

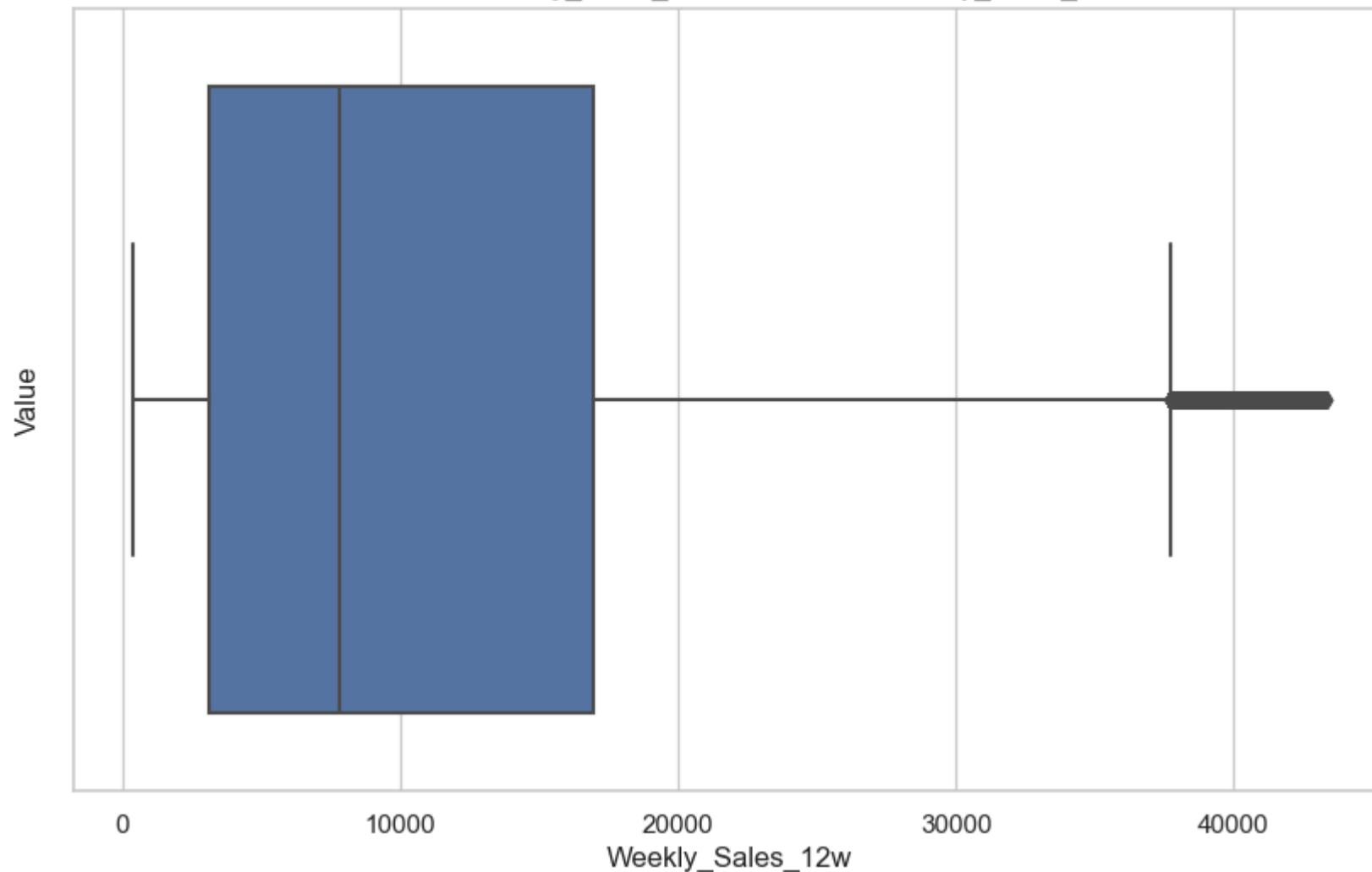


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_12w with Weekly_Sales_12w

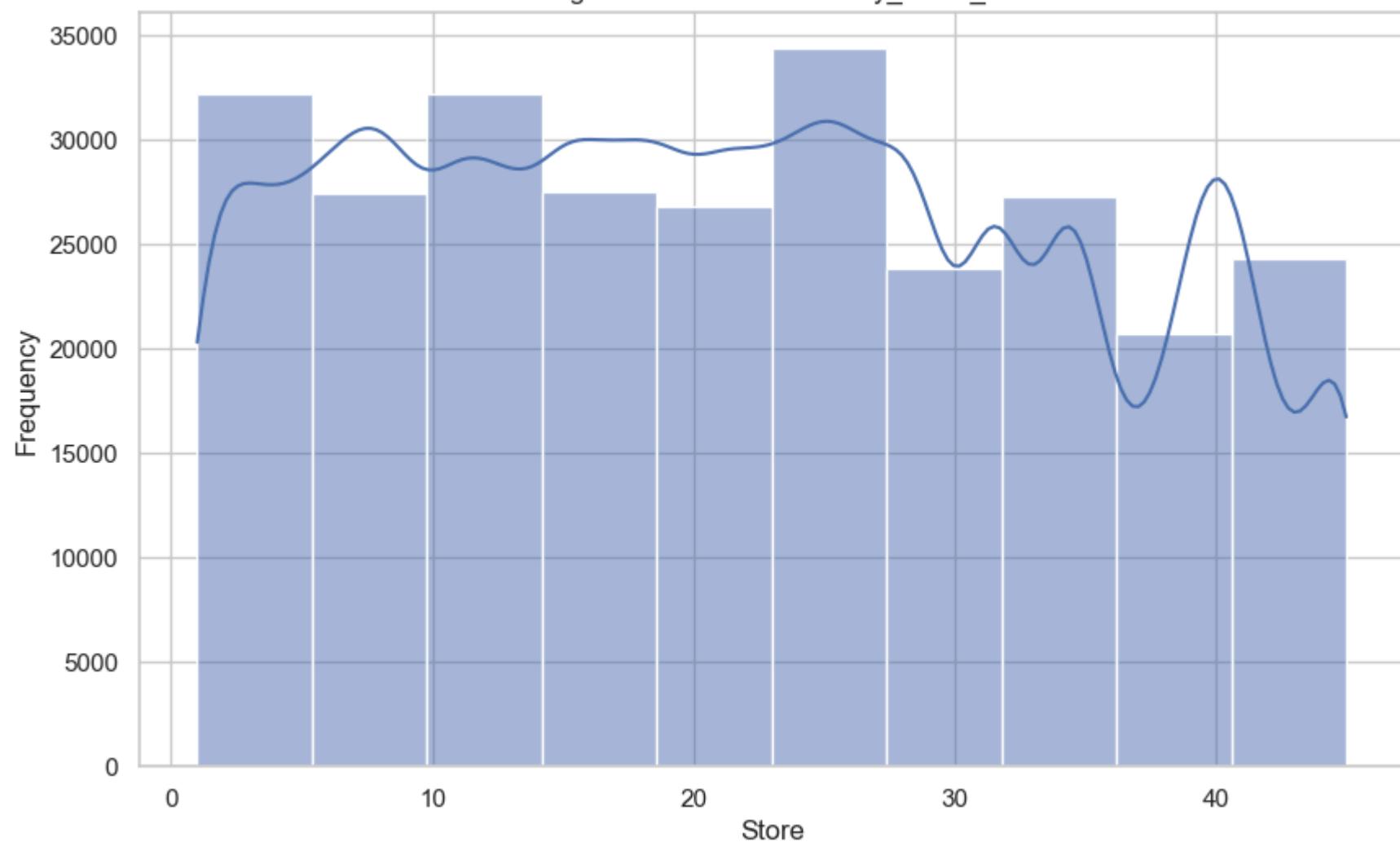


Box Plot of Weekly_Sales_12w in Data with Weekly_Sales_12w

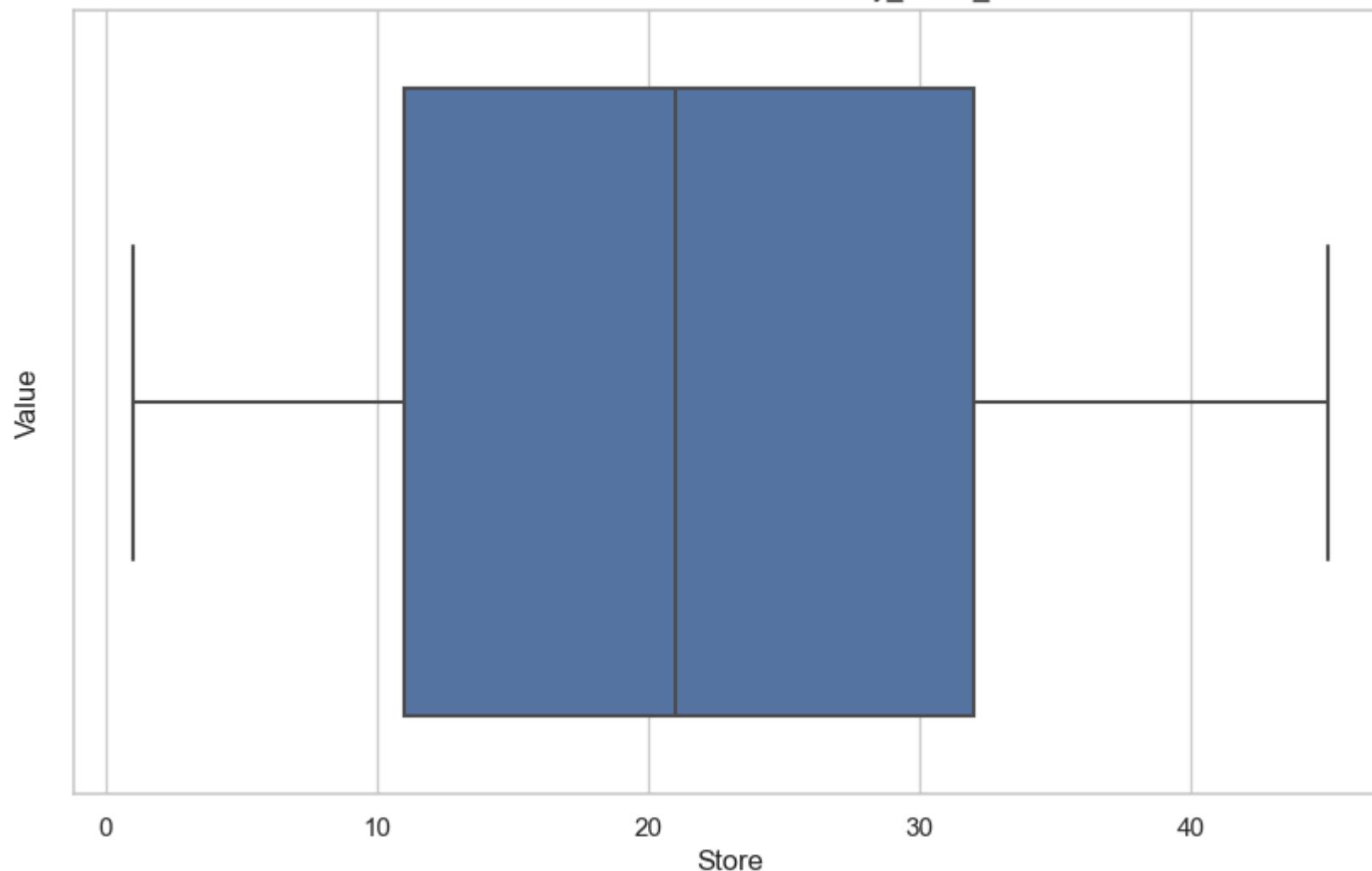


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Store with Weekly_Sales_13w

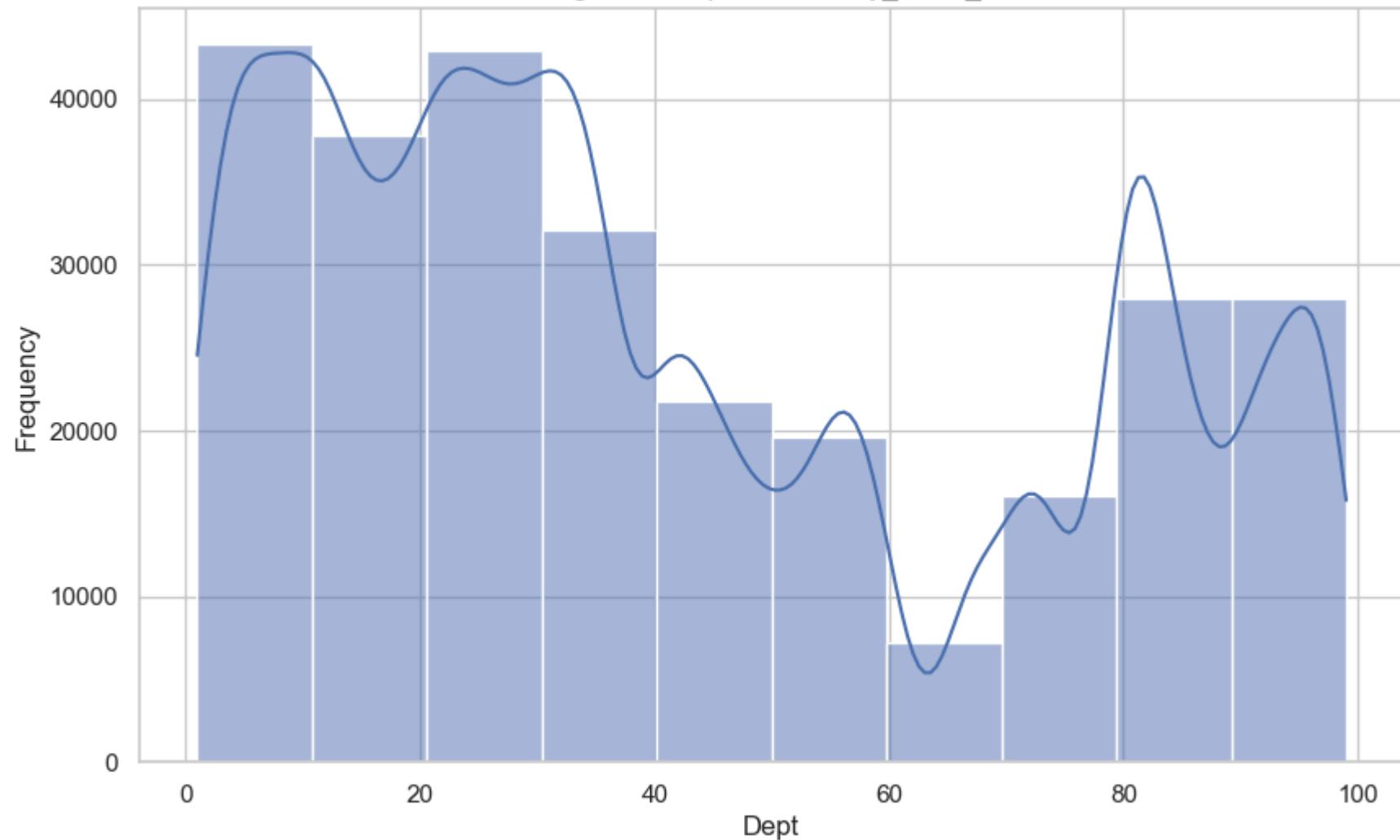


Box Plot of Store in Data with Weekly_Sales_13w

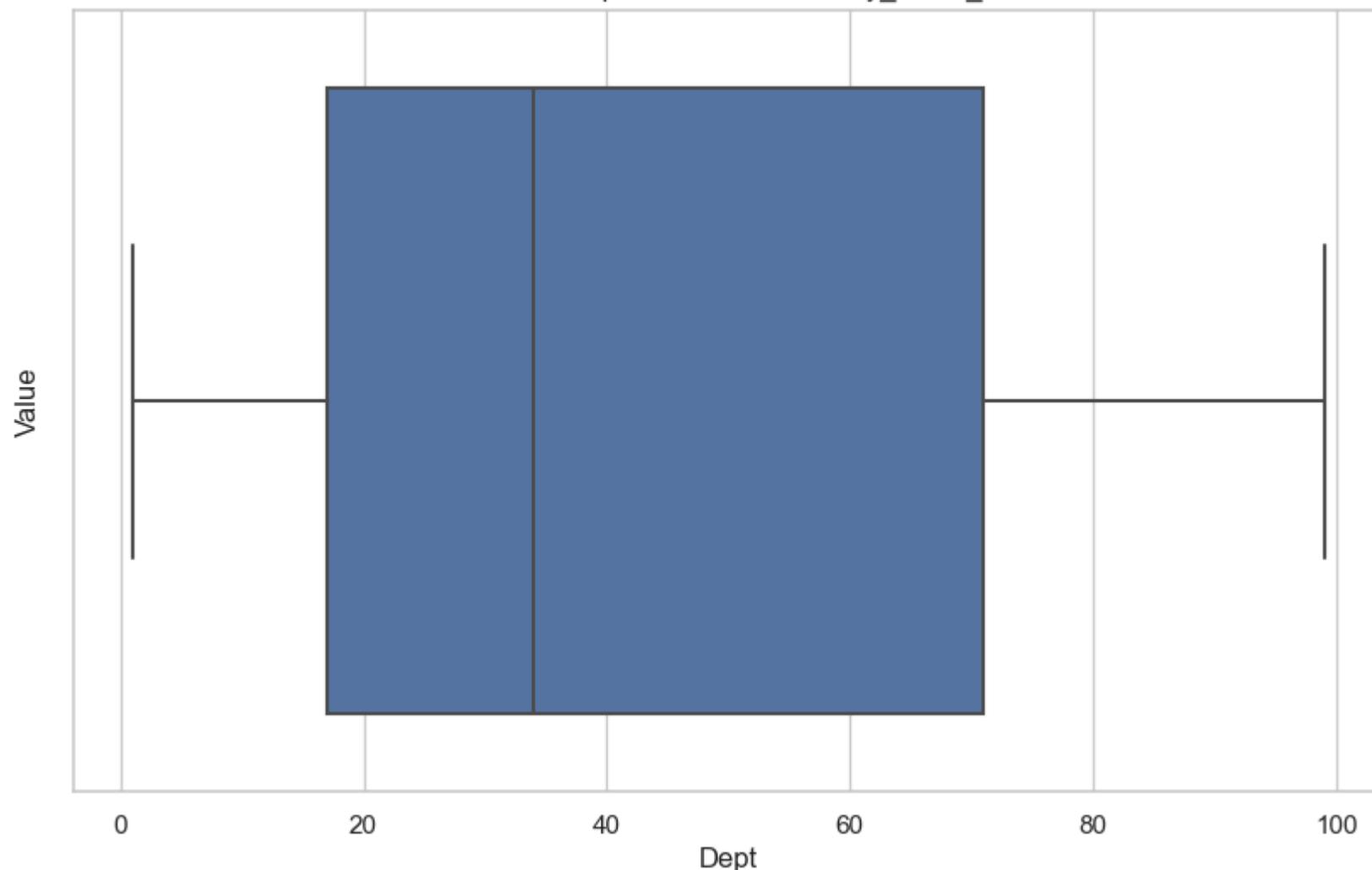


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

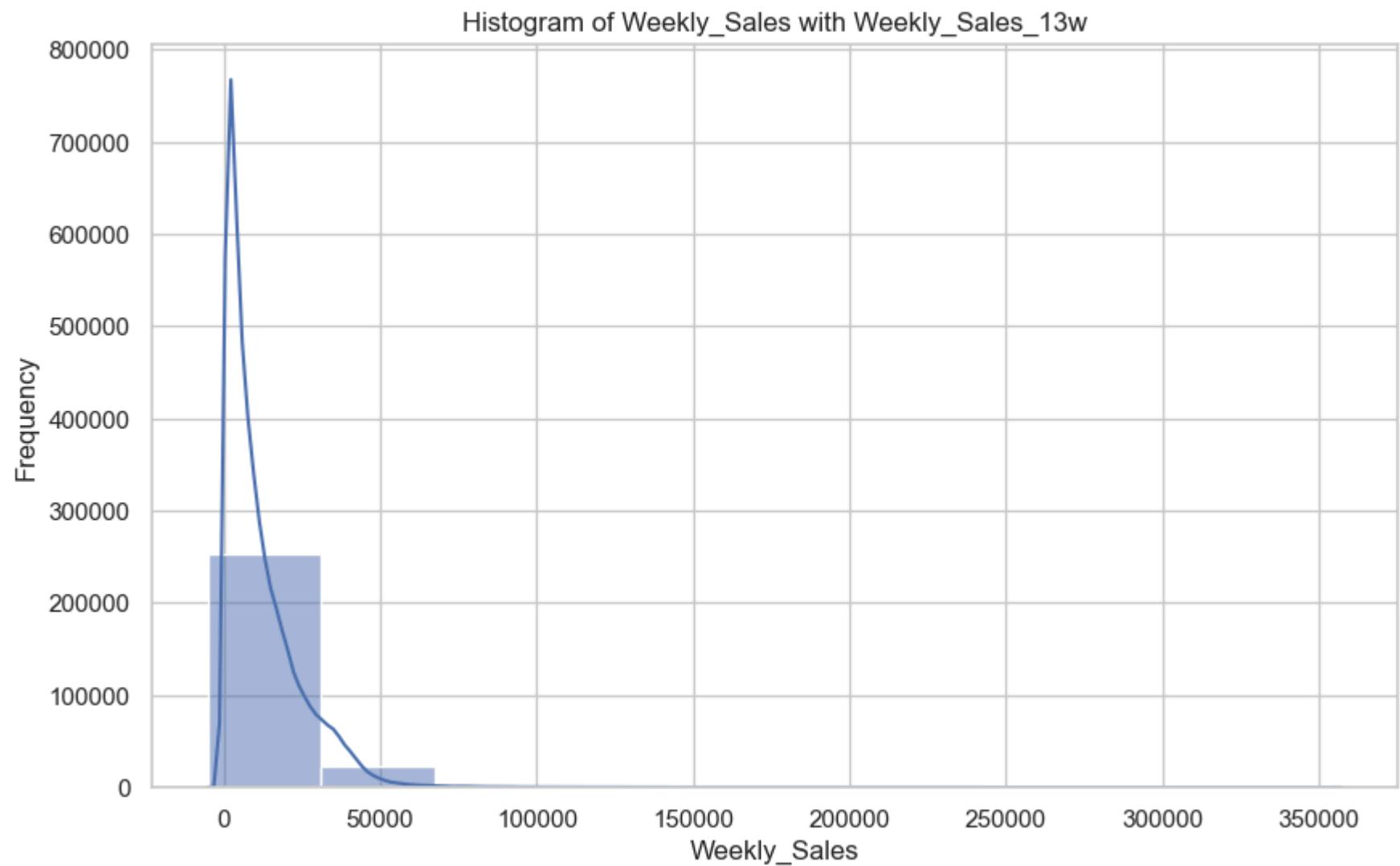
Histogram of Dept with Weekly_Sales_13w



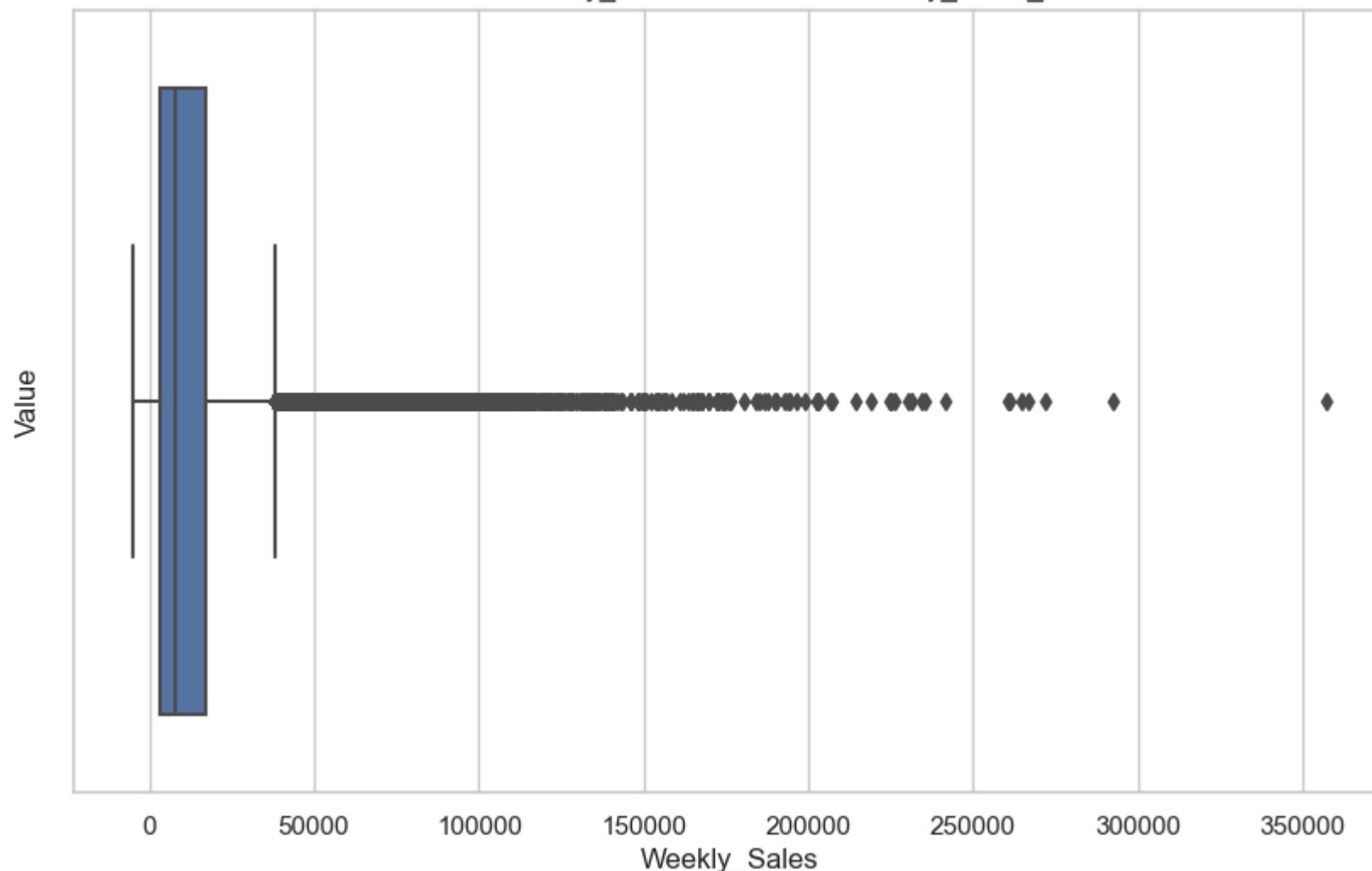
Box Plot of Dept in Data with Weekly_Sales_13w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

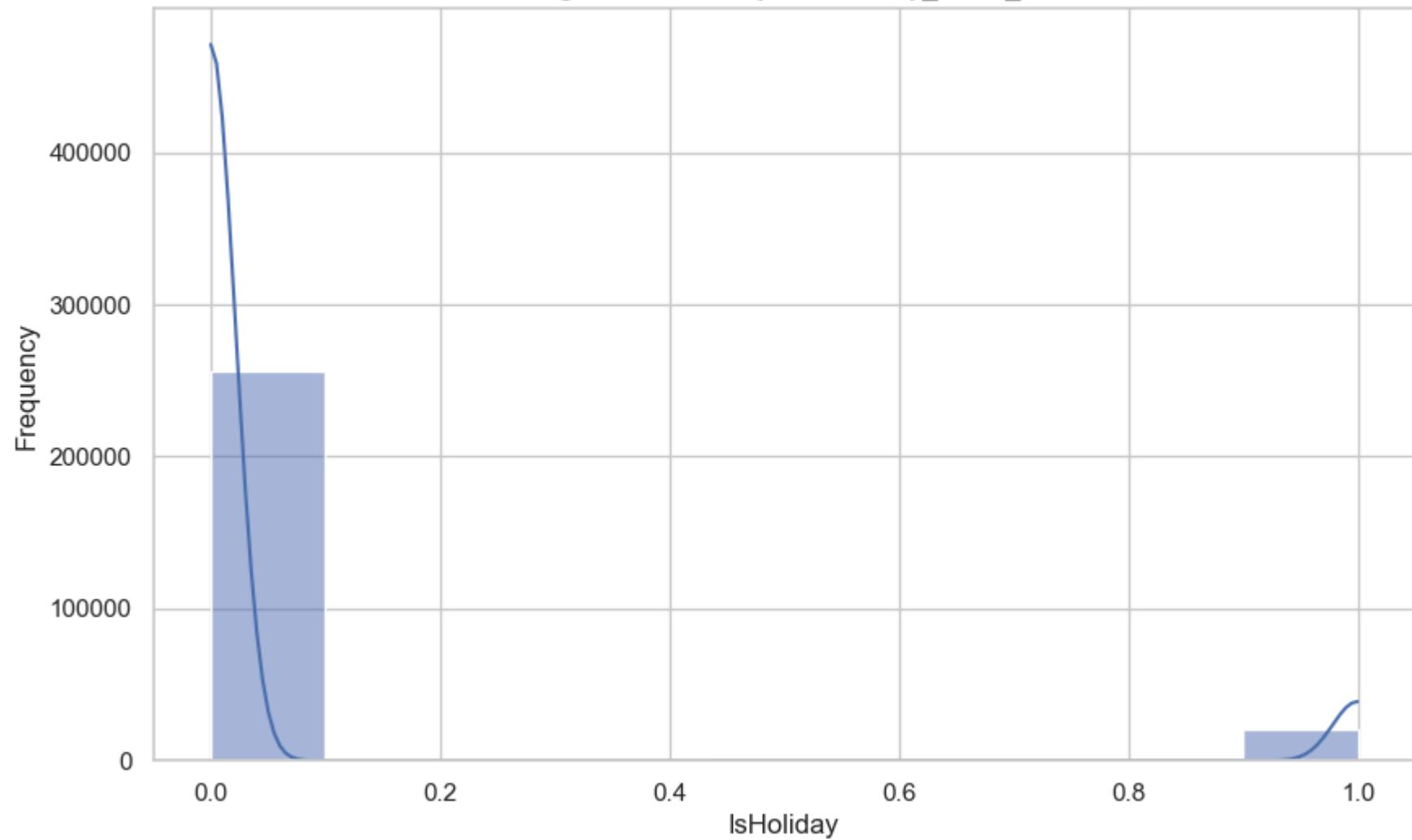


Box Plot of Weekly_Sales in Data with Weekly_Sales_13w

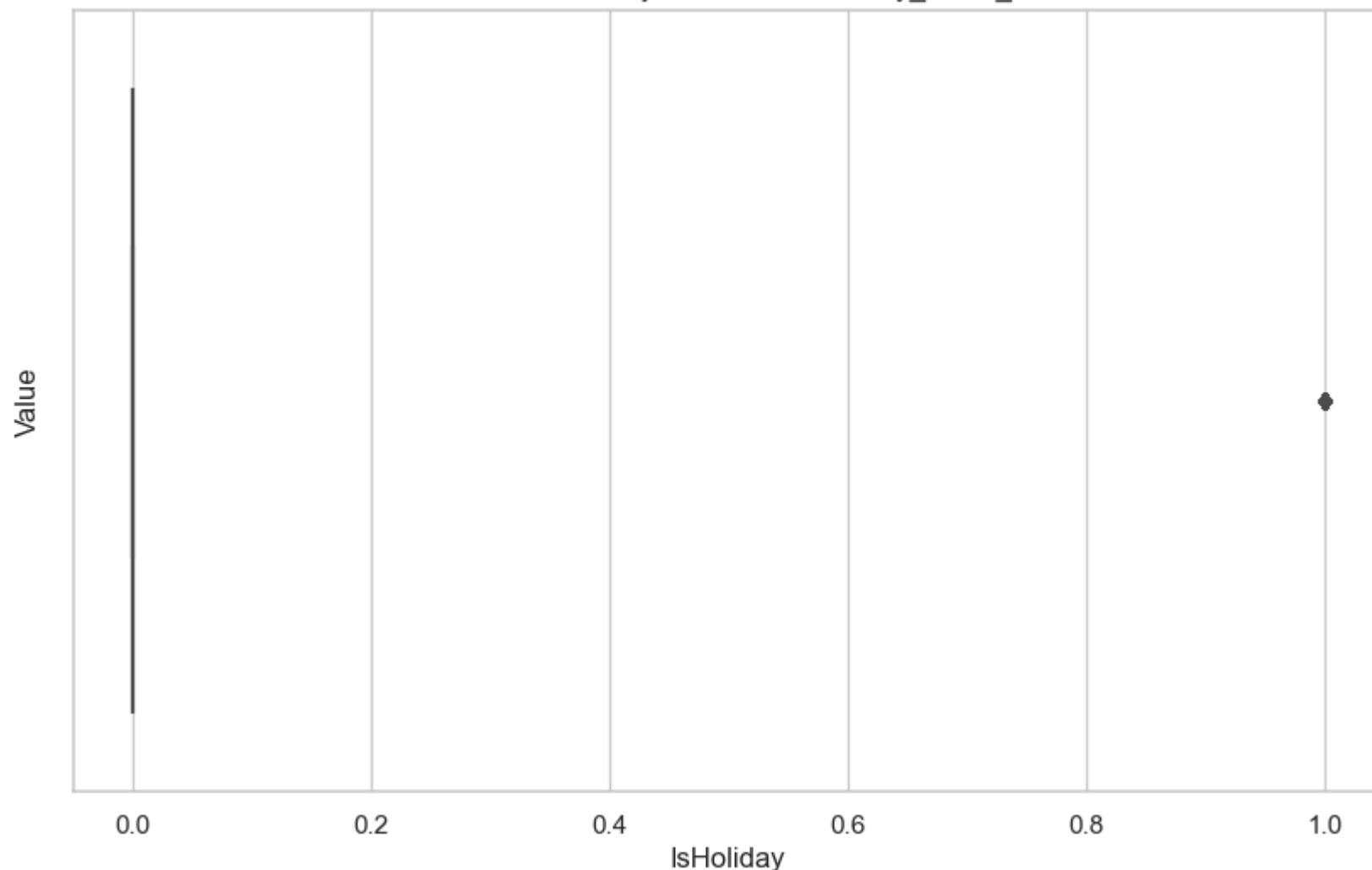


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of IsHoliday with Weekly_Sales_13w

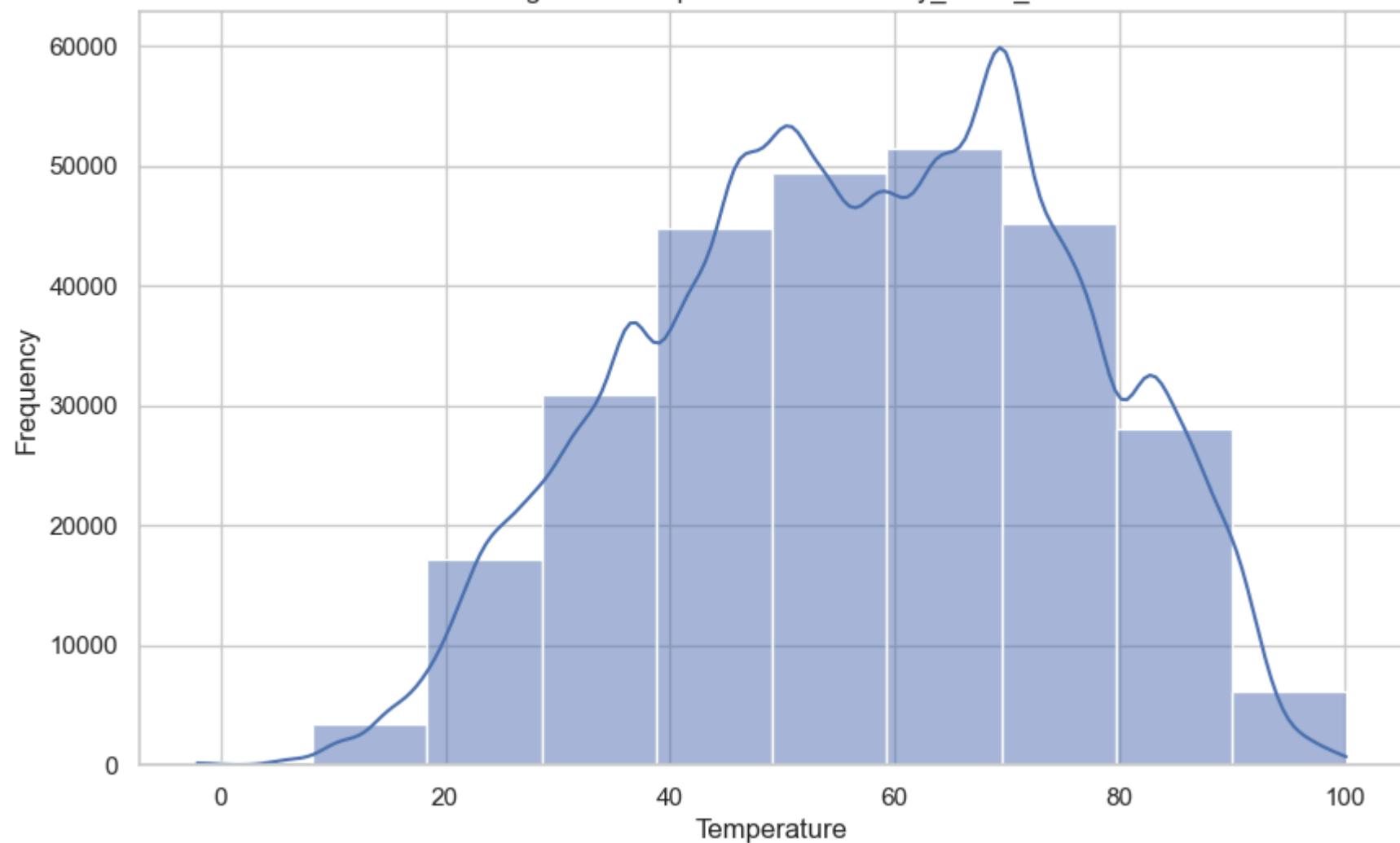


Box Plot of IsHoliday in Data with Weekly_Sales_13w

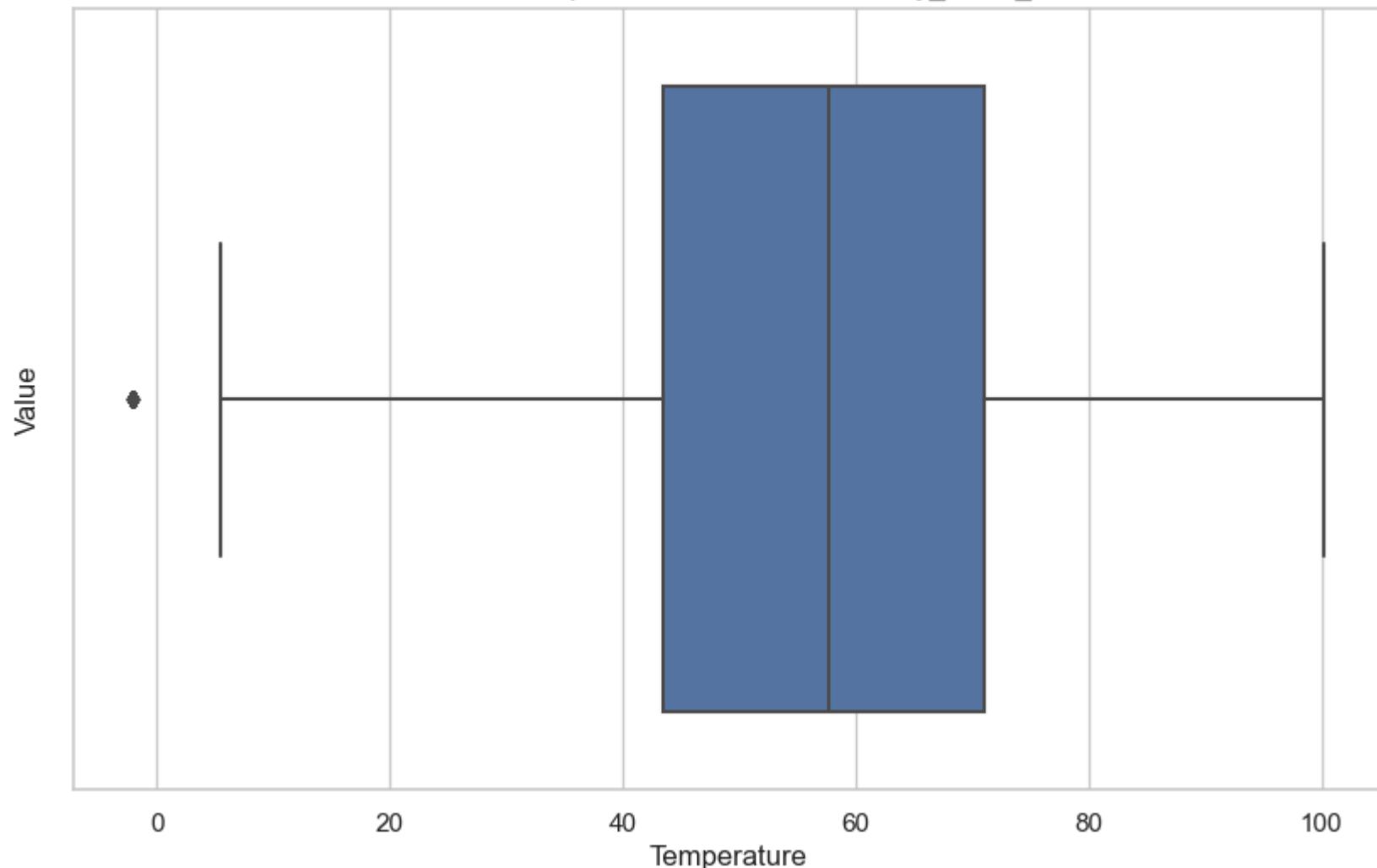


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Temperature with Weekly_Sales_13w

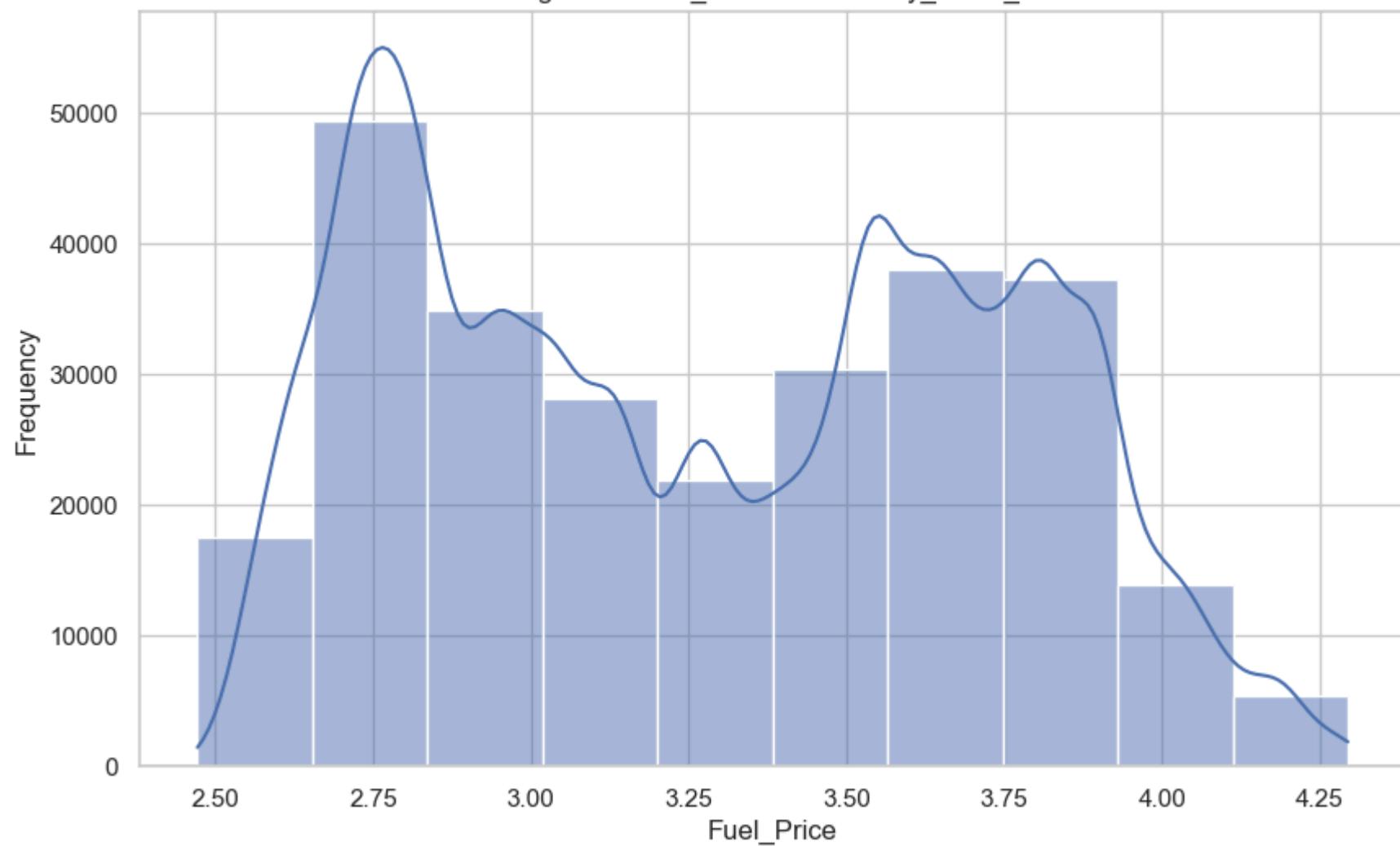


Box Plot of Temperature in Data with Weekly_Sales_13w

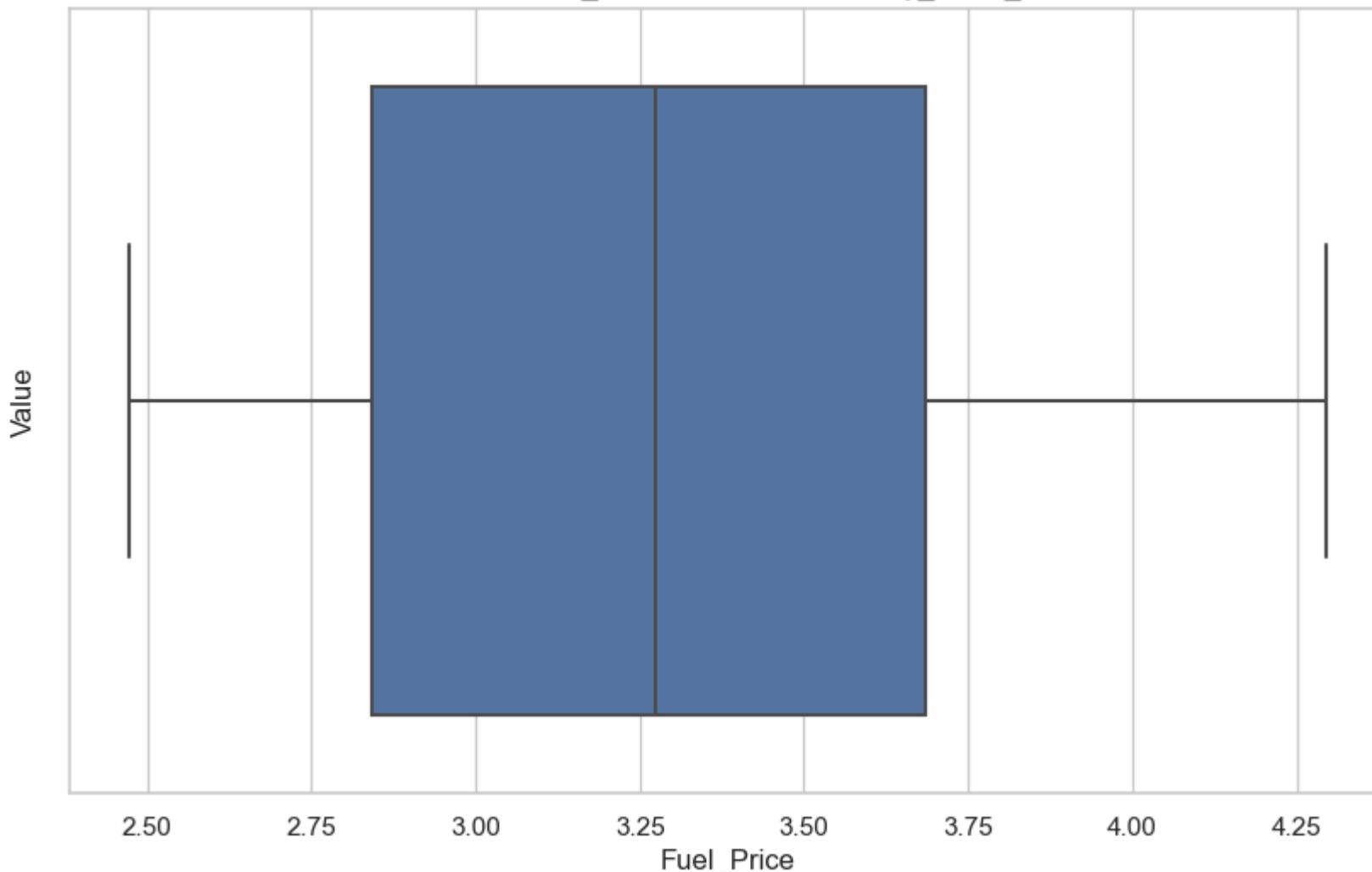


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Fuel_Price with Weekly_Sales_13w

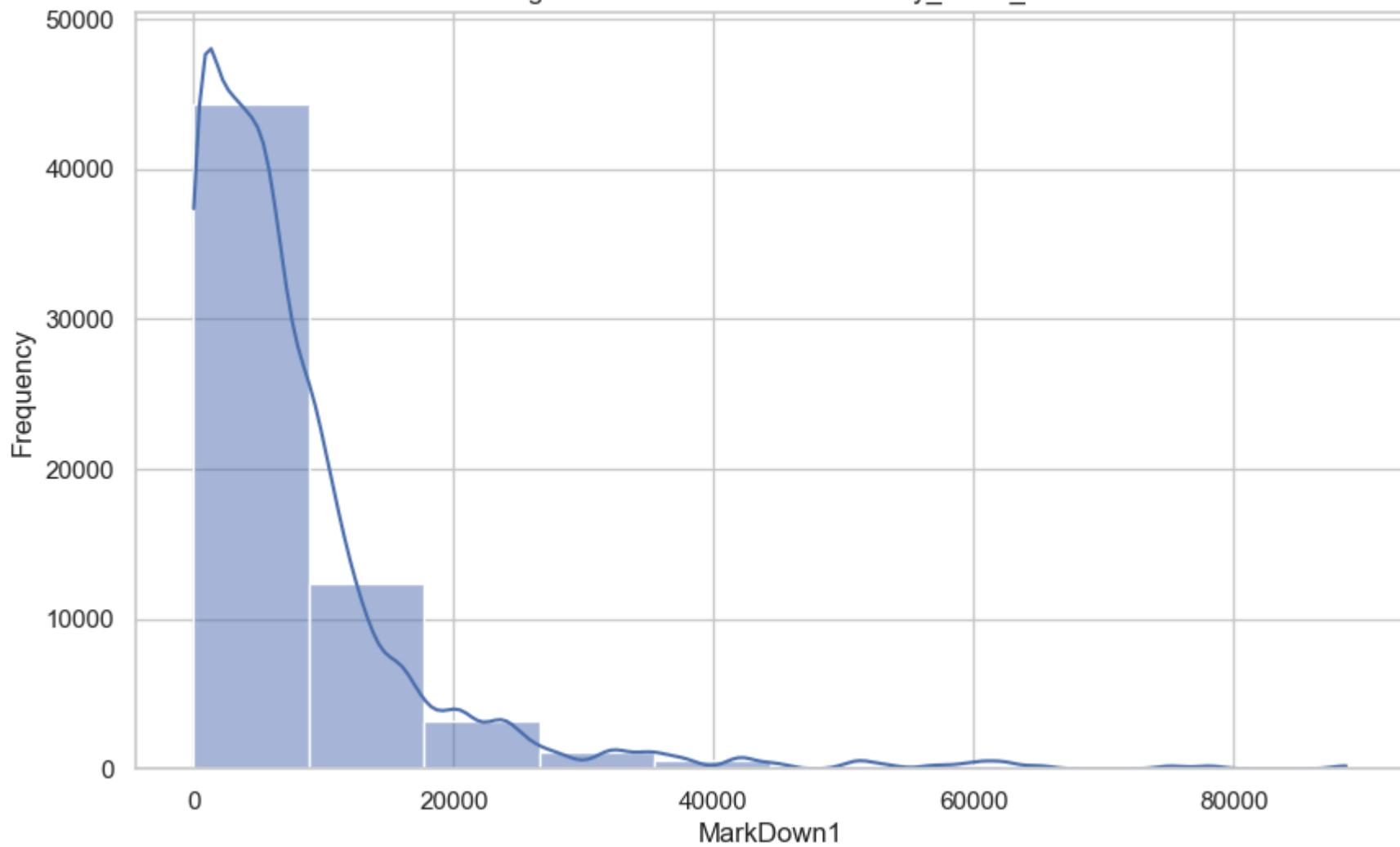


Box Plot of Fuel_Price in Data with Weekly_Sales_13w

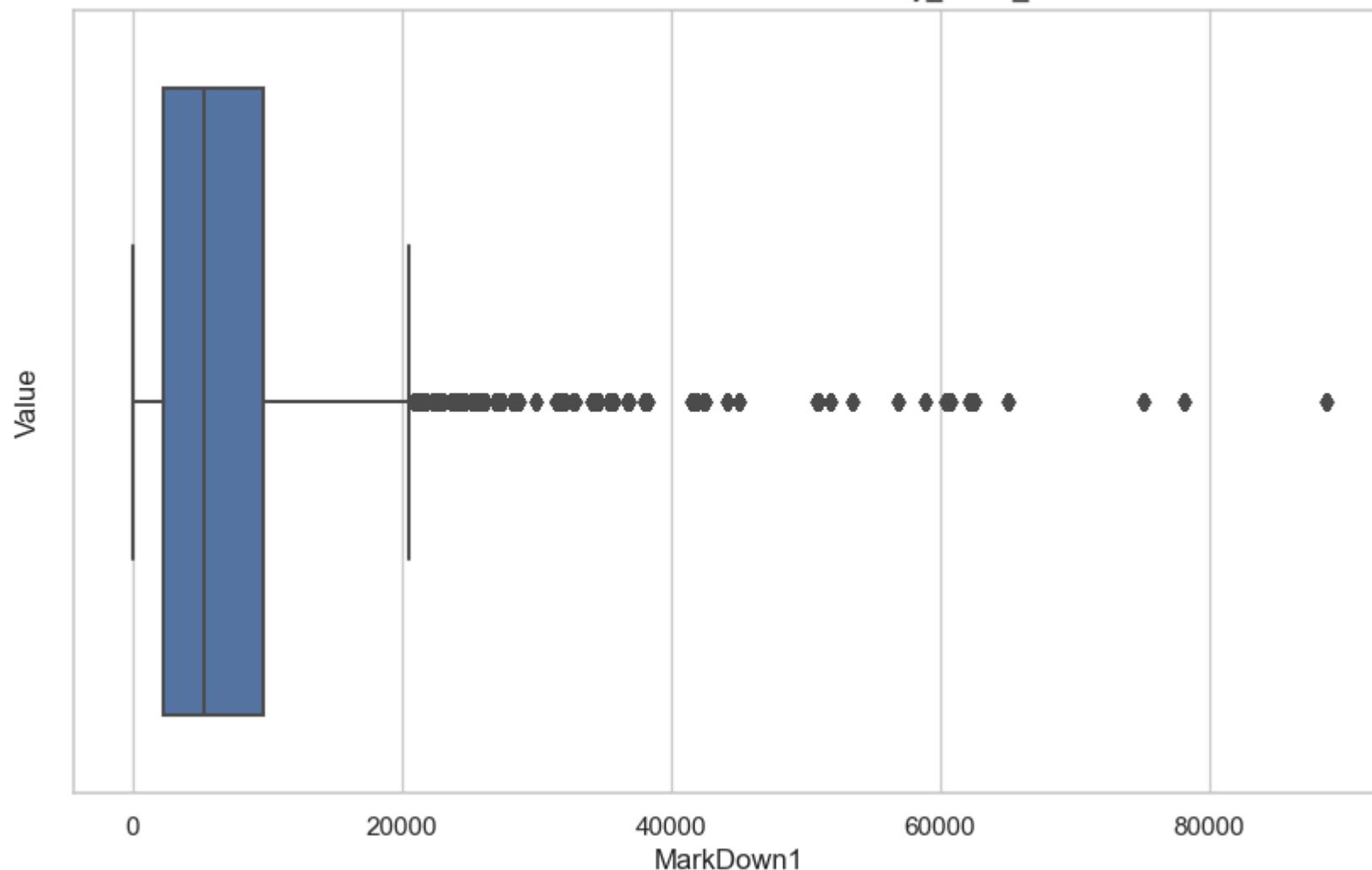


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown1 with Weekly_Sales_13w

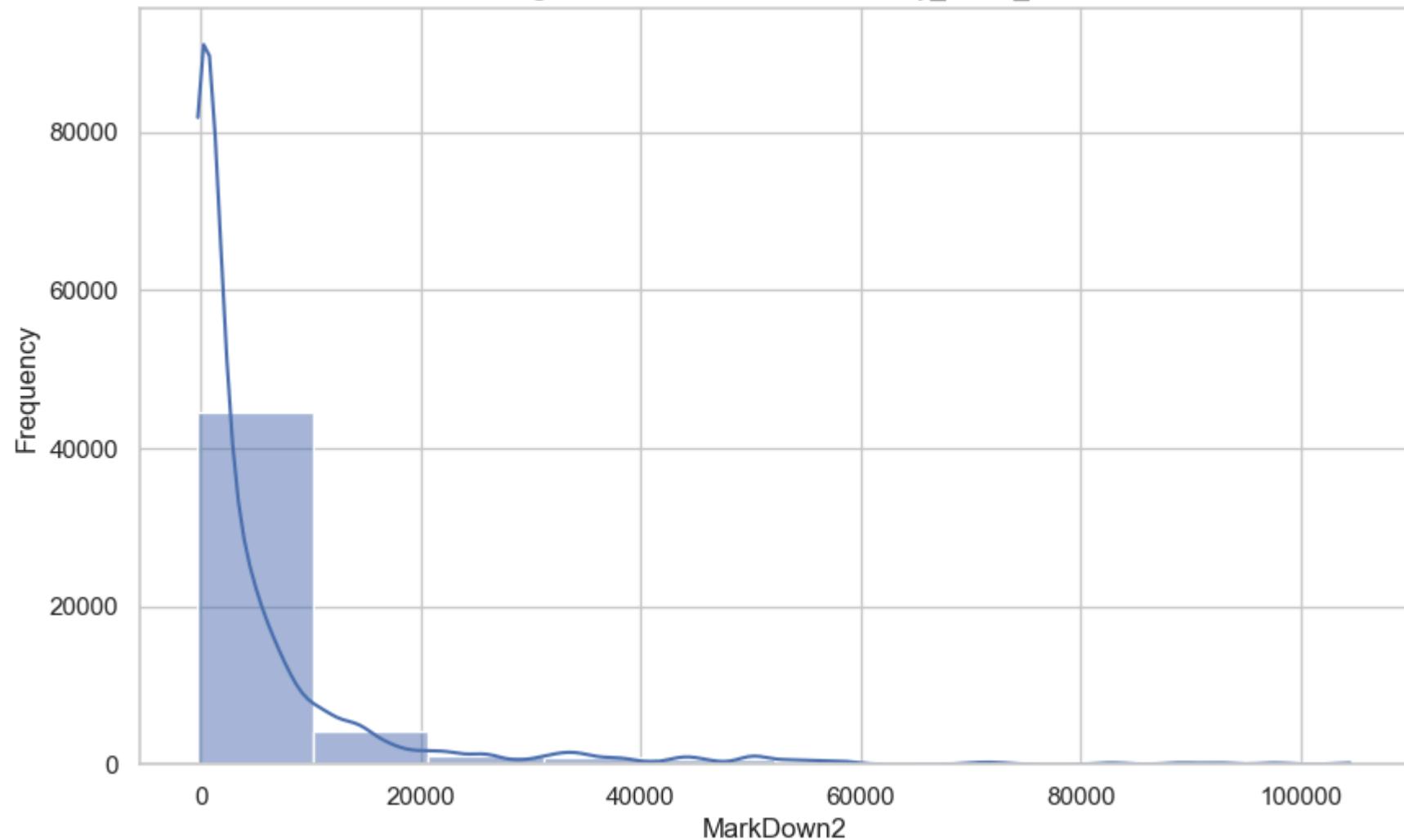


Box Plot of MarkDown1 in Data with Weekly_Sales_13w

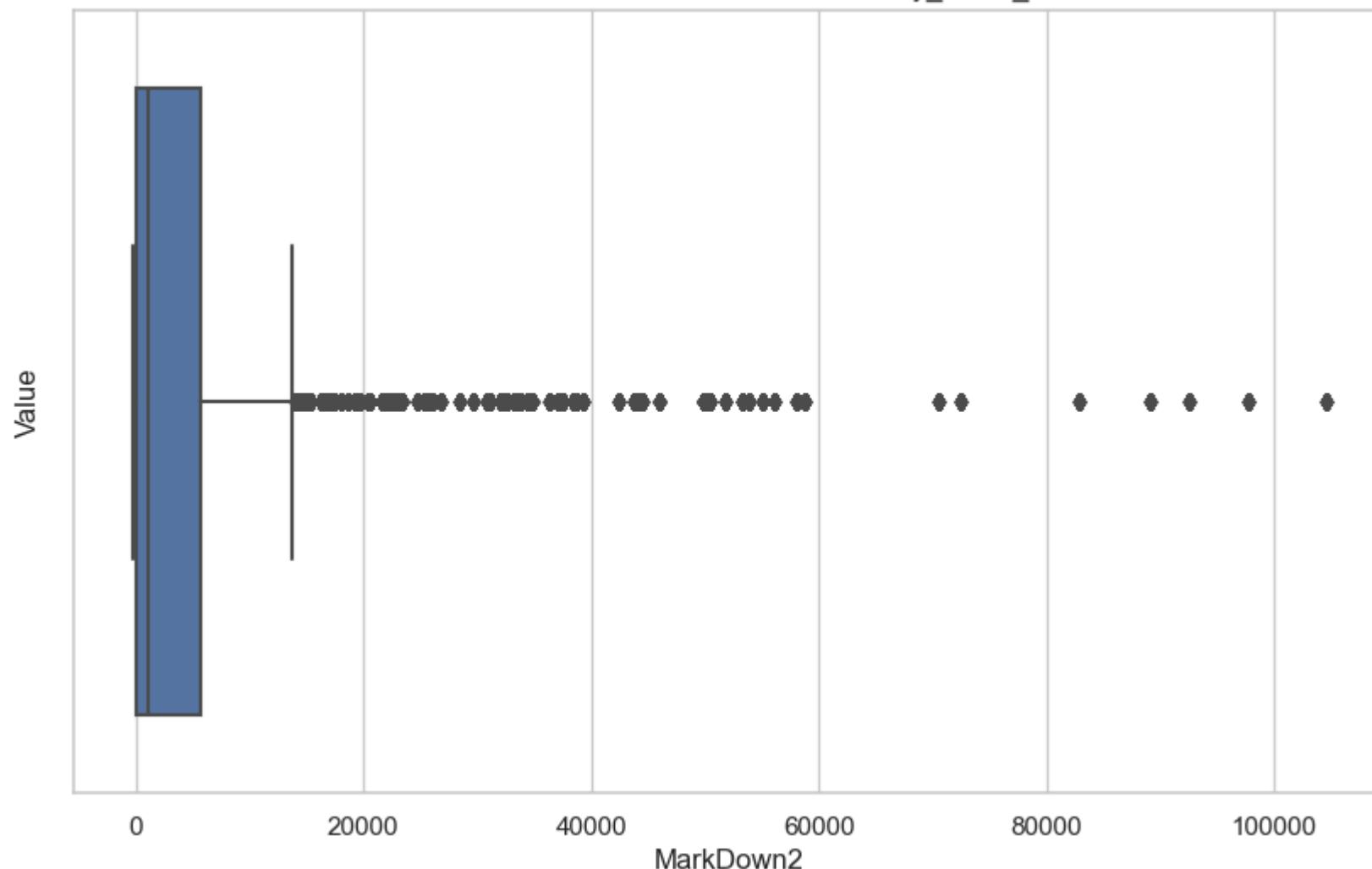


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown2 with Weekly_Sales_13w

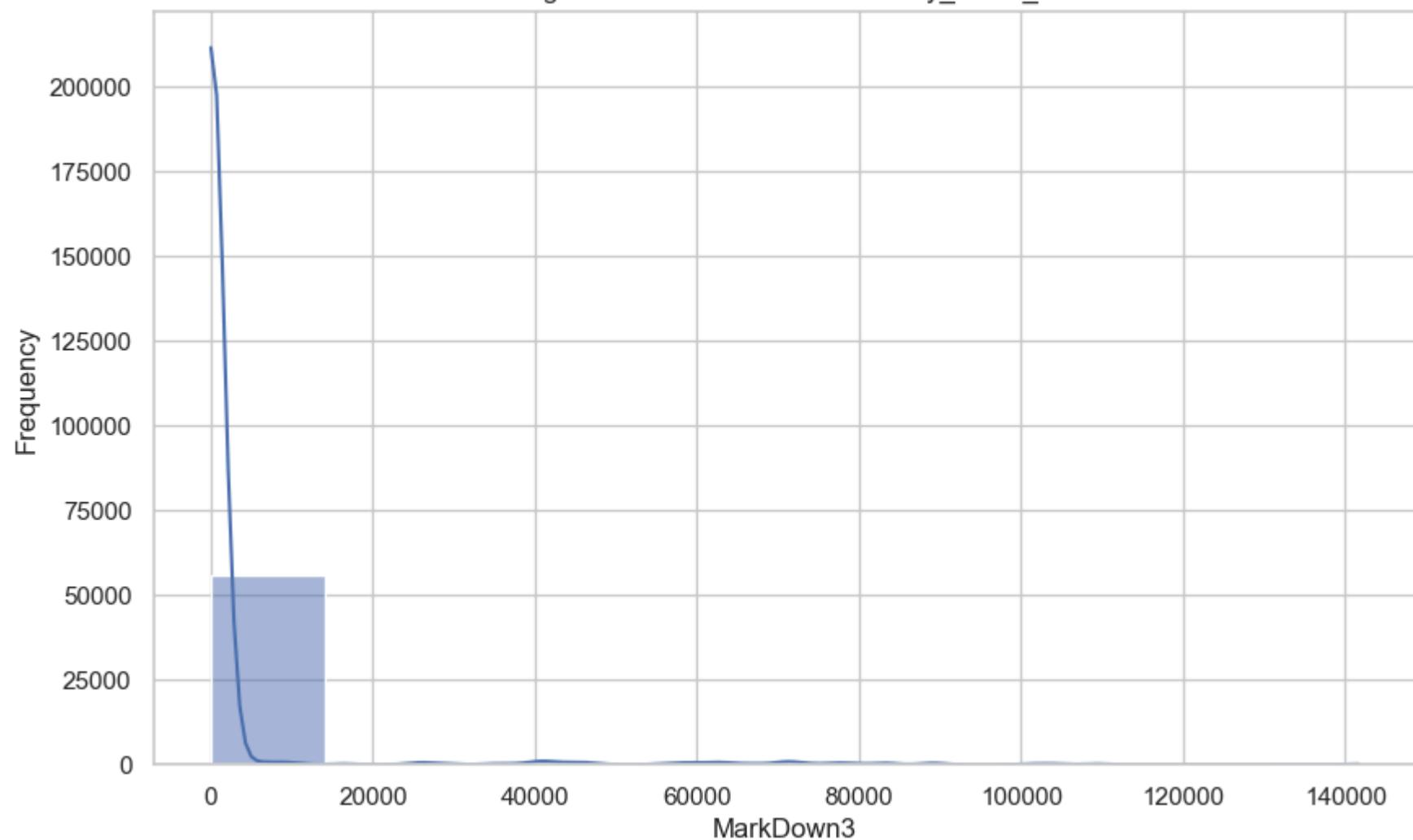


Box Plot of MarkDown2 in Data with Weekly_Sales_13w

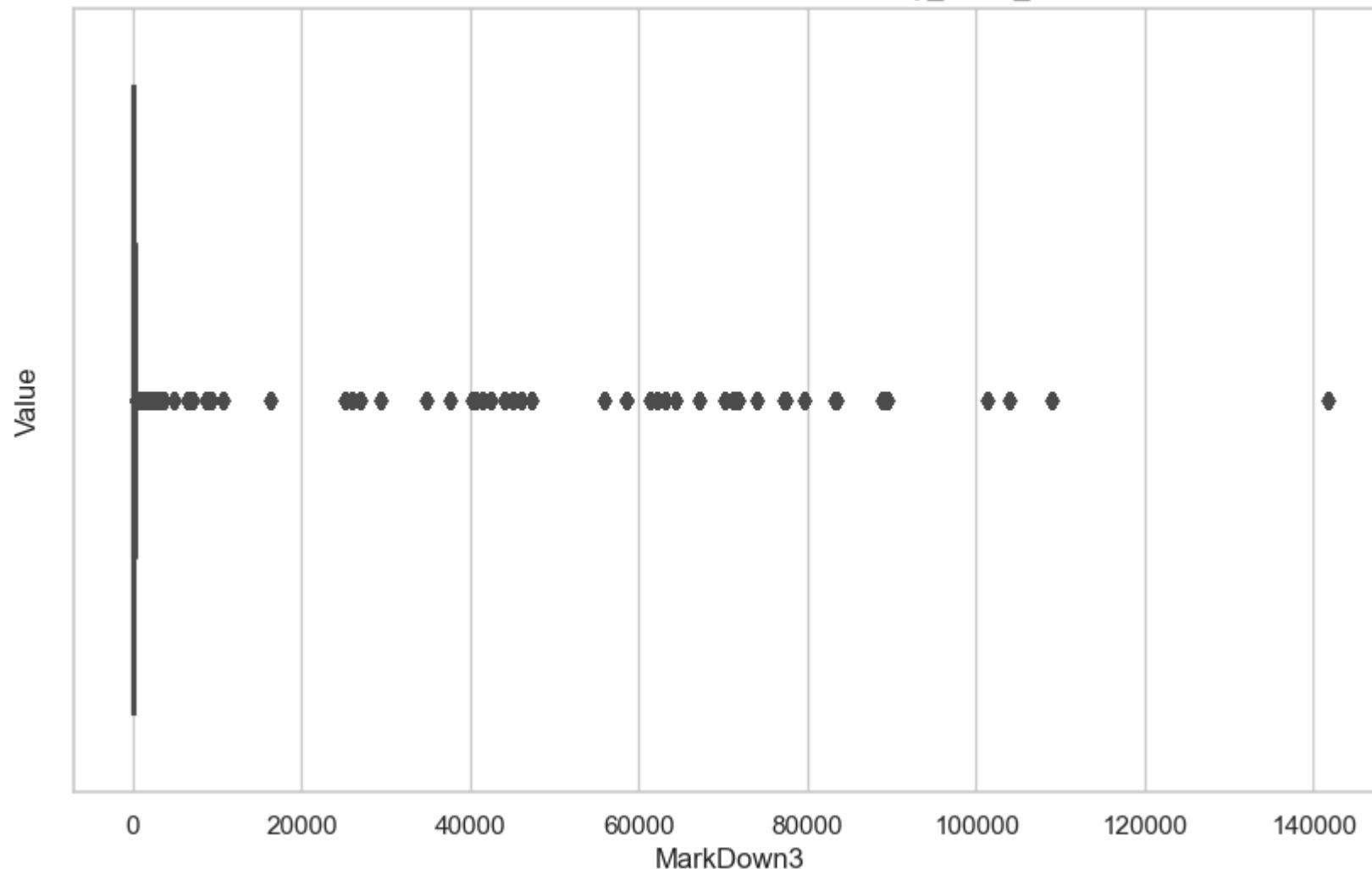


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown3 with Weekly_Sales_13w

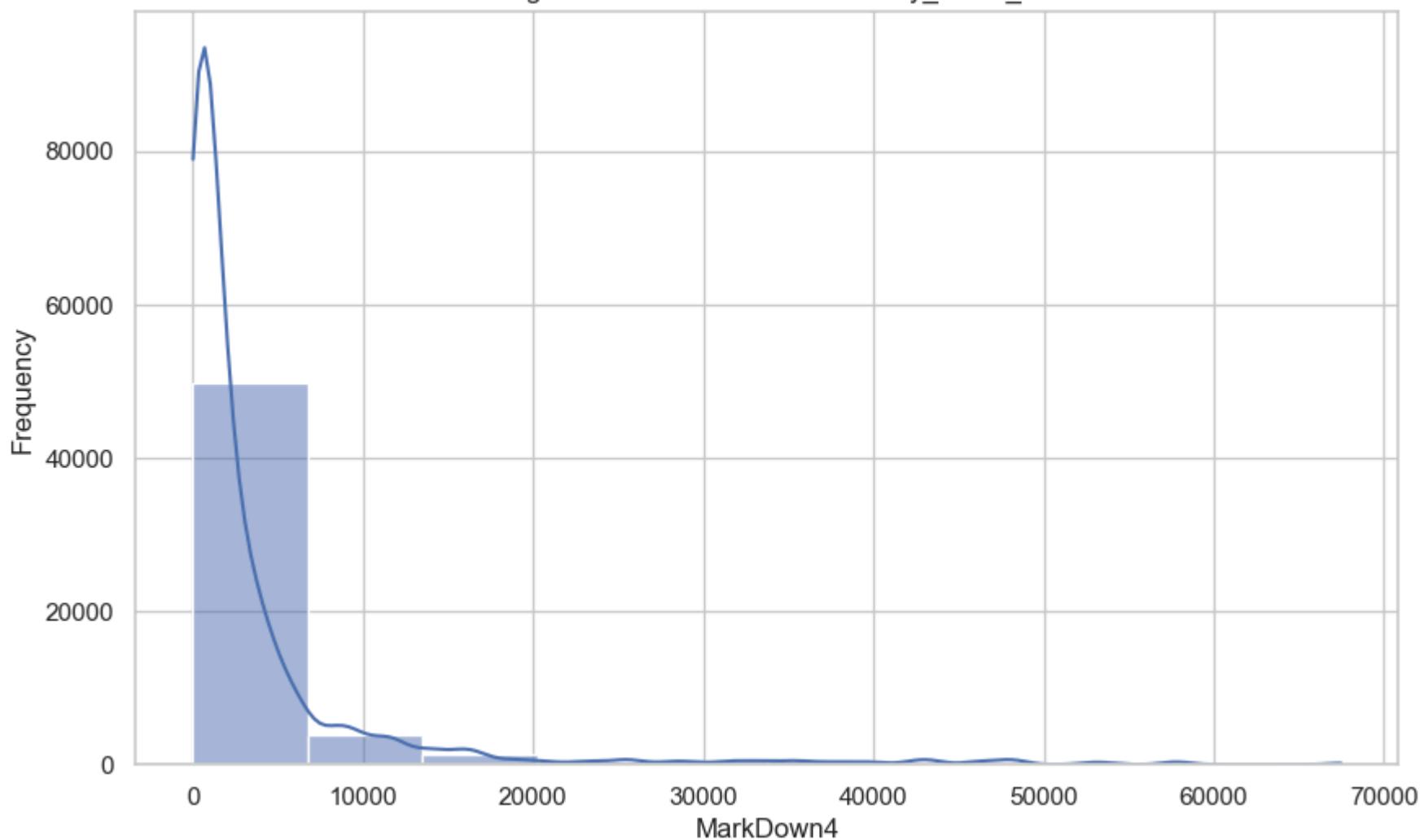


Box Plot of MarkDown3 in Data with Weekly_Sales_13w

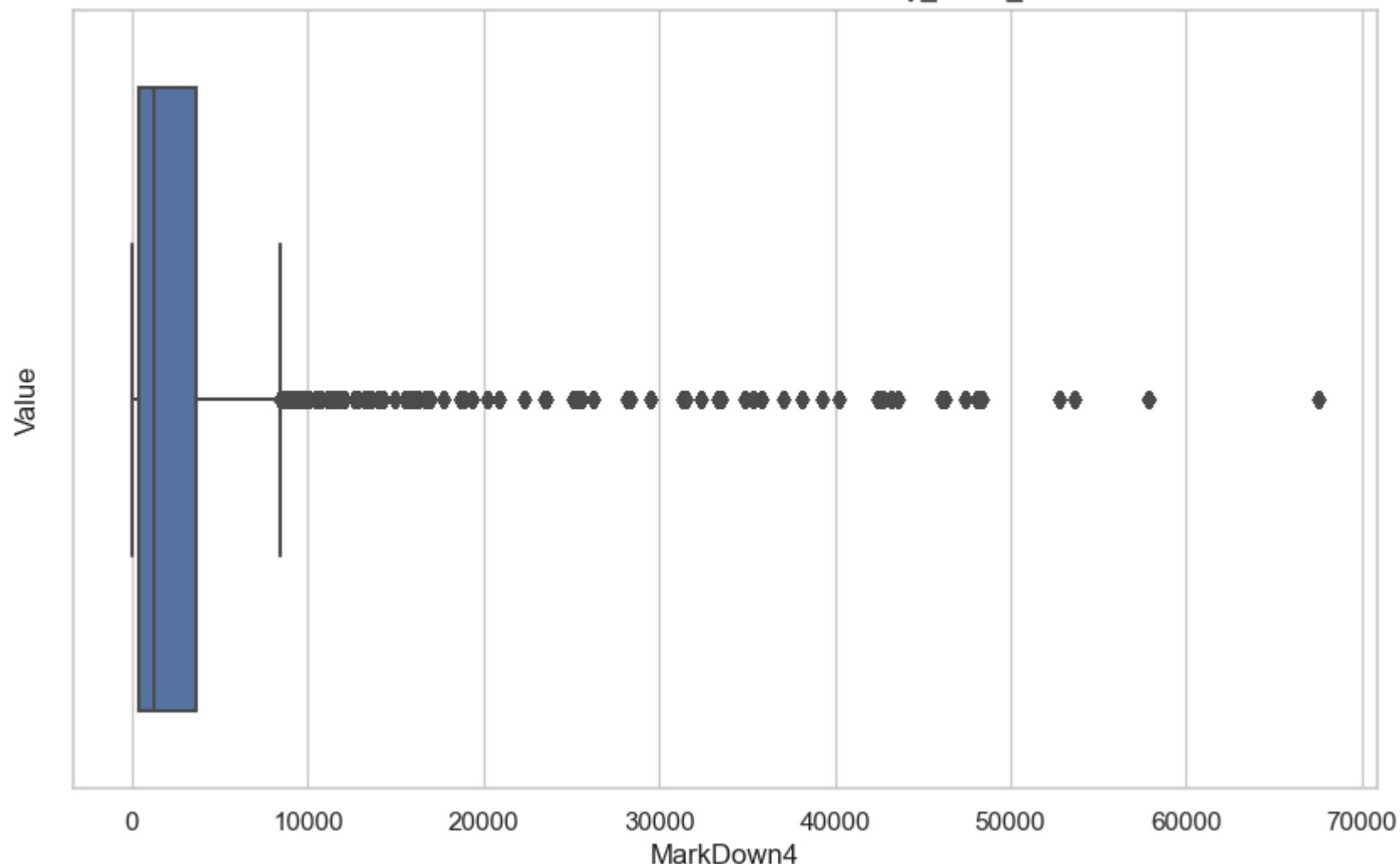


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown4 with Weekly_Sales_13w

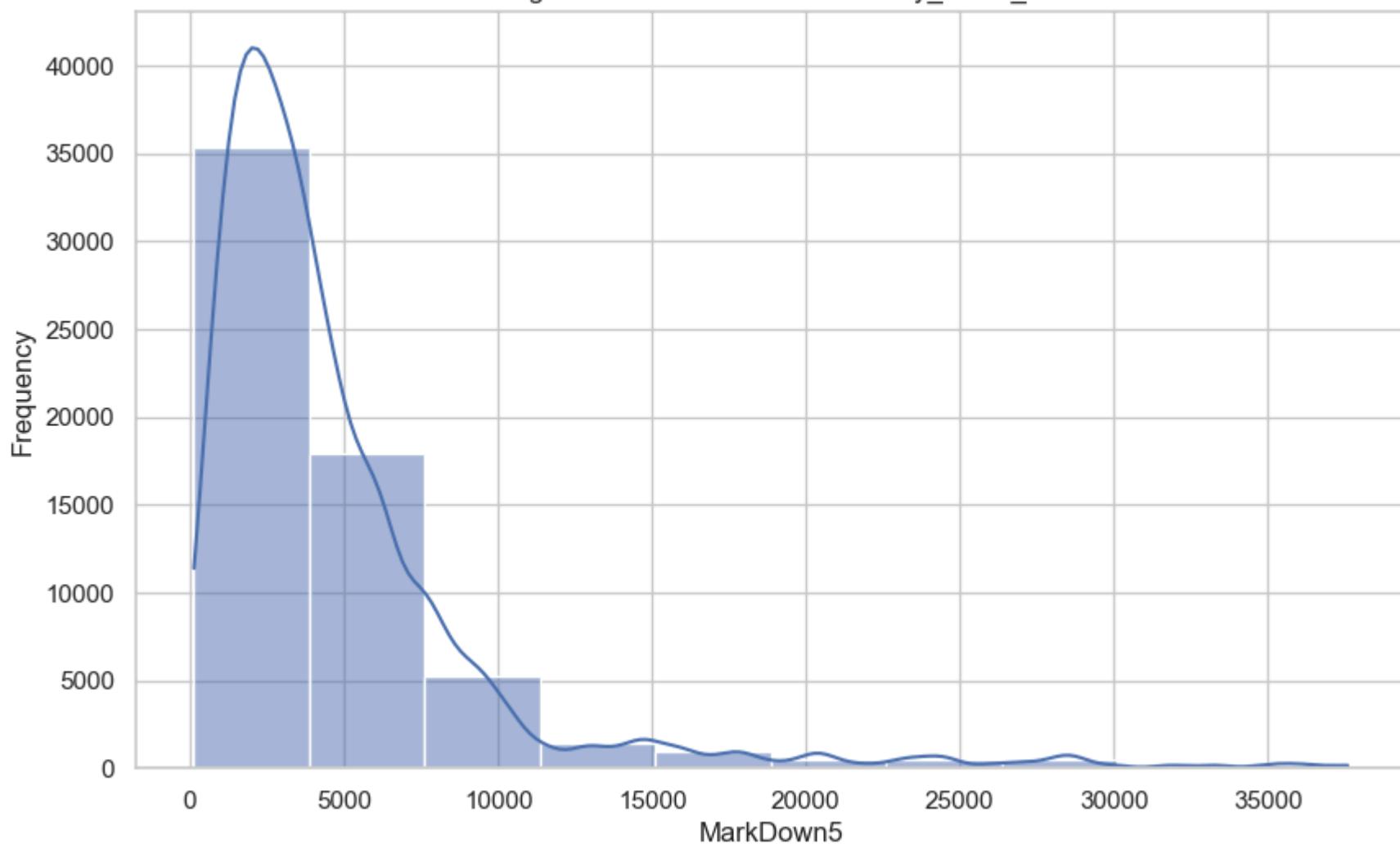


Box Plot of MarkDown4 in Data with Weekly_Sales_13w

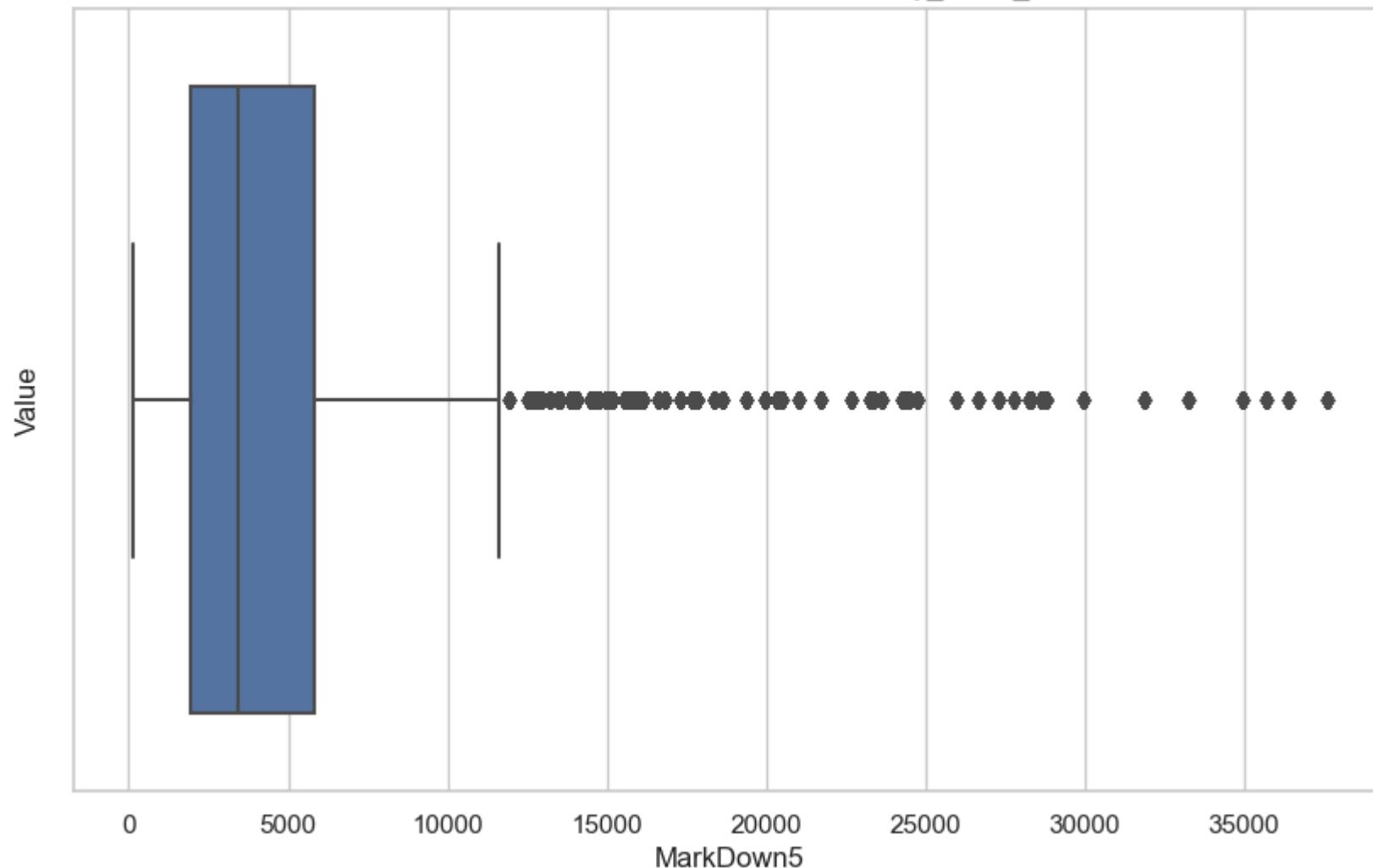


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of MarkDown5 with Weekly_Sales_13w

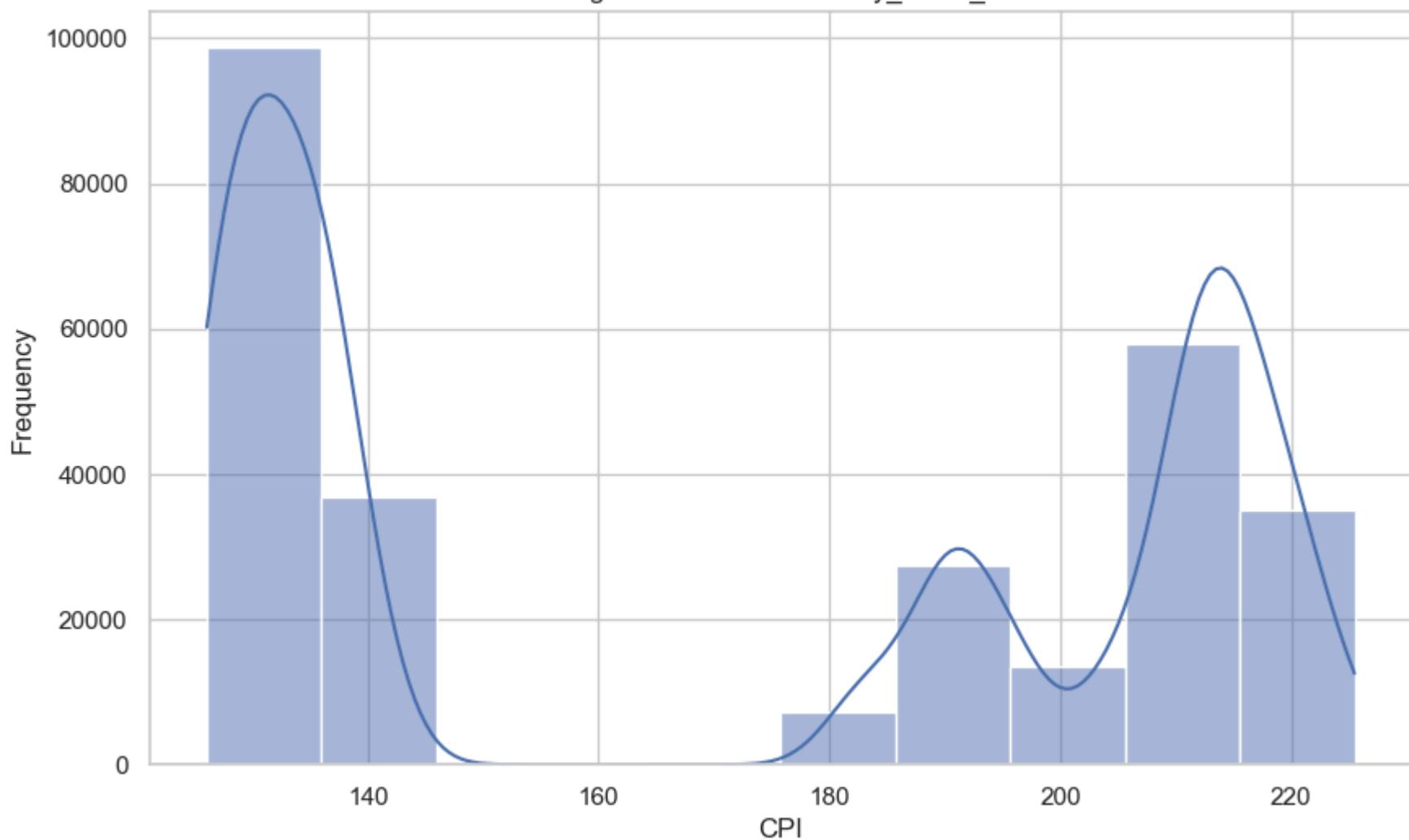


Box Plot of MarkDown5 in Data with Weekly_Sales_13w

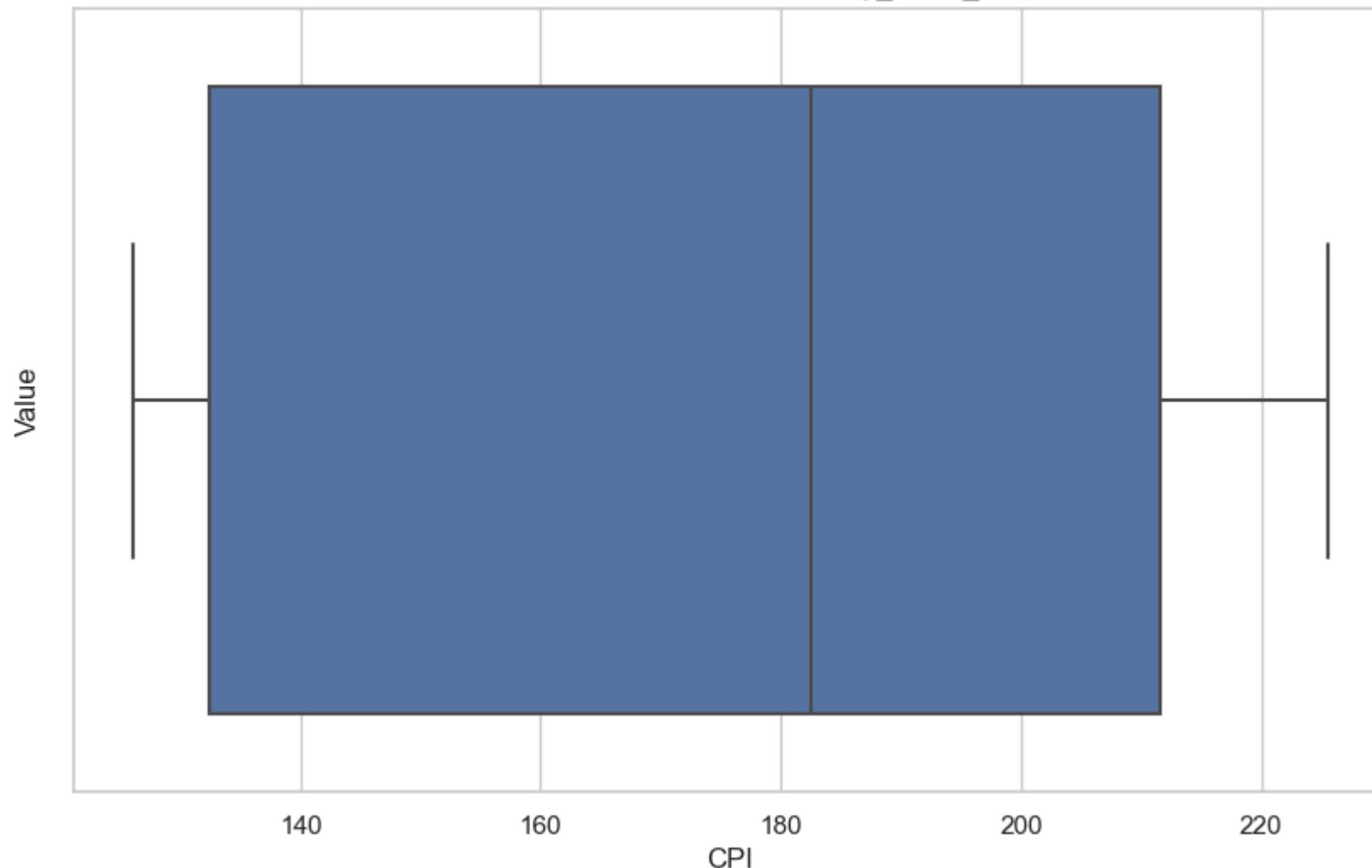


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of CPI with Weekly_Sales_13w

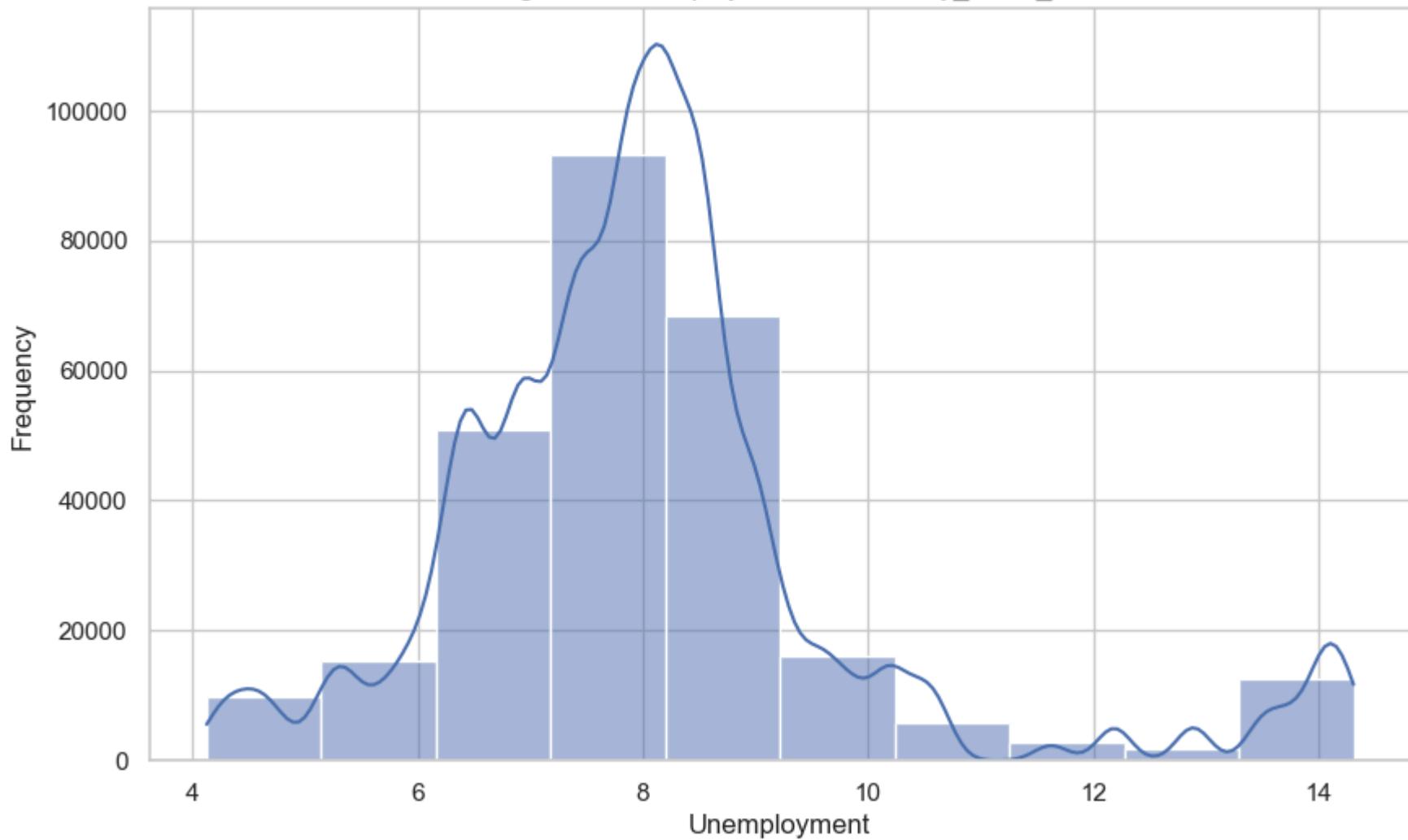


Box Plot of CPI in Data with Weekly_Sales_13w

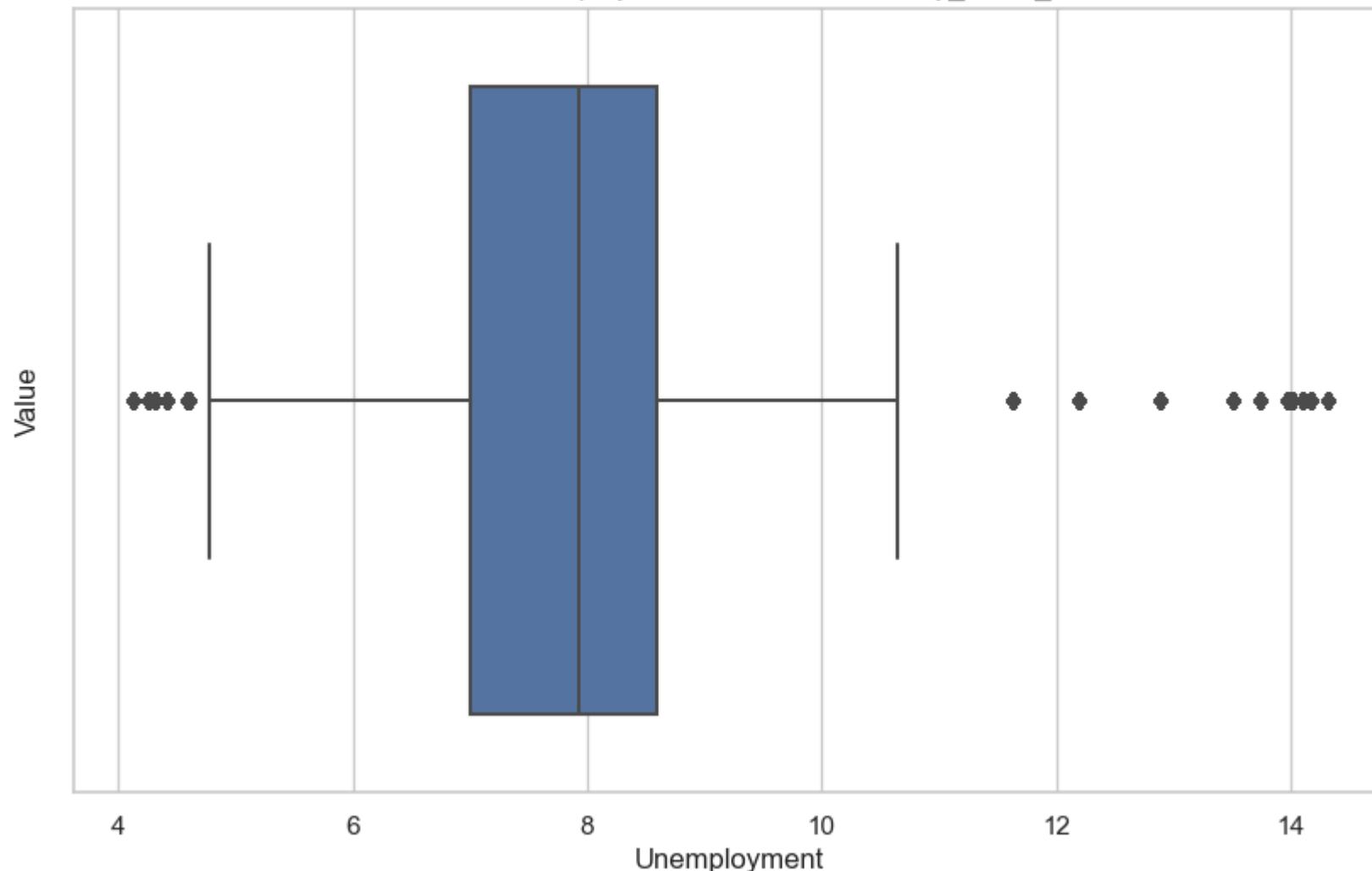


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Unemployment with Weekly_Sales_13w

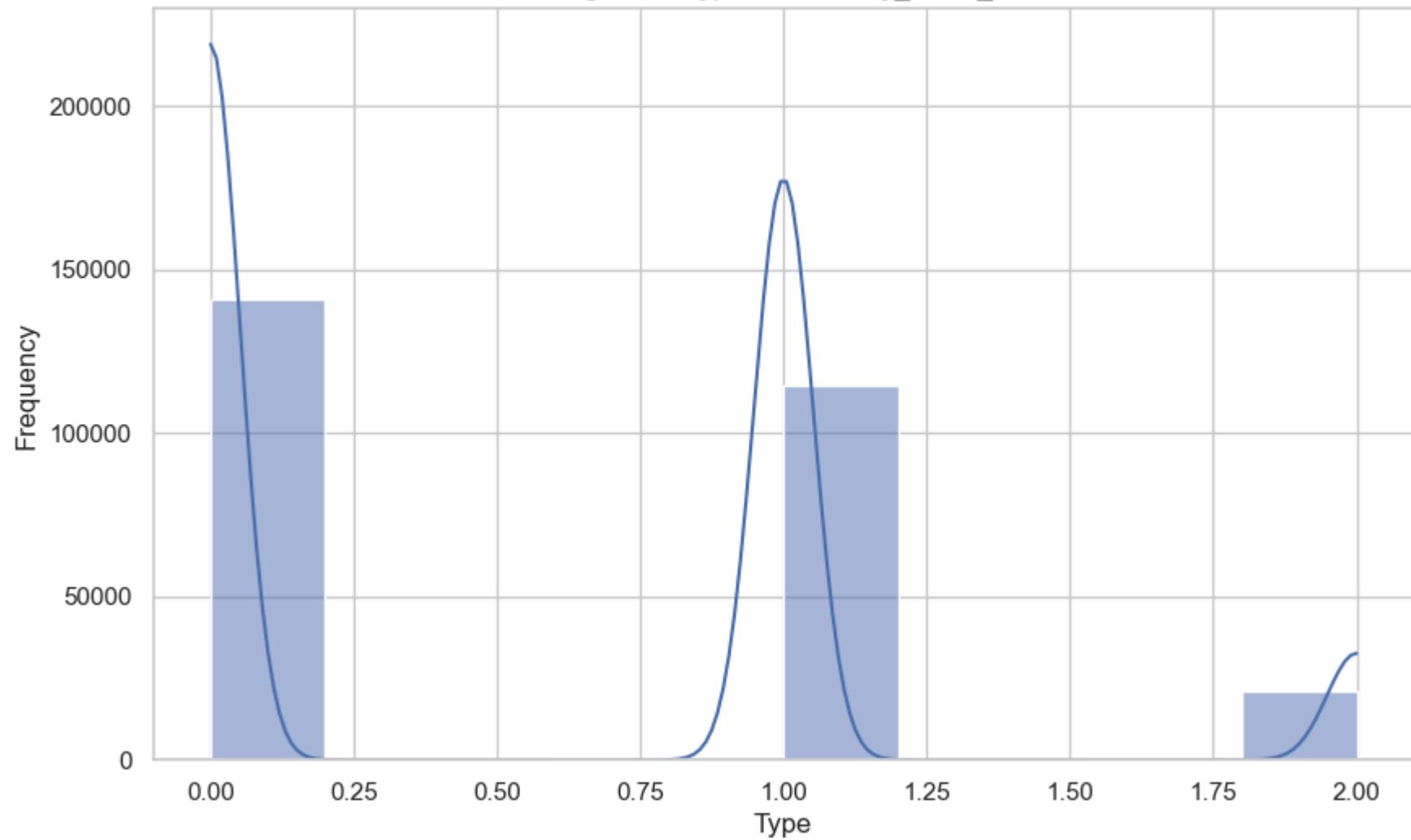


Box Plot of Unemployment in Data with Weekly_Sales_13w

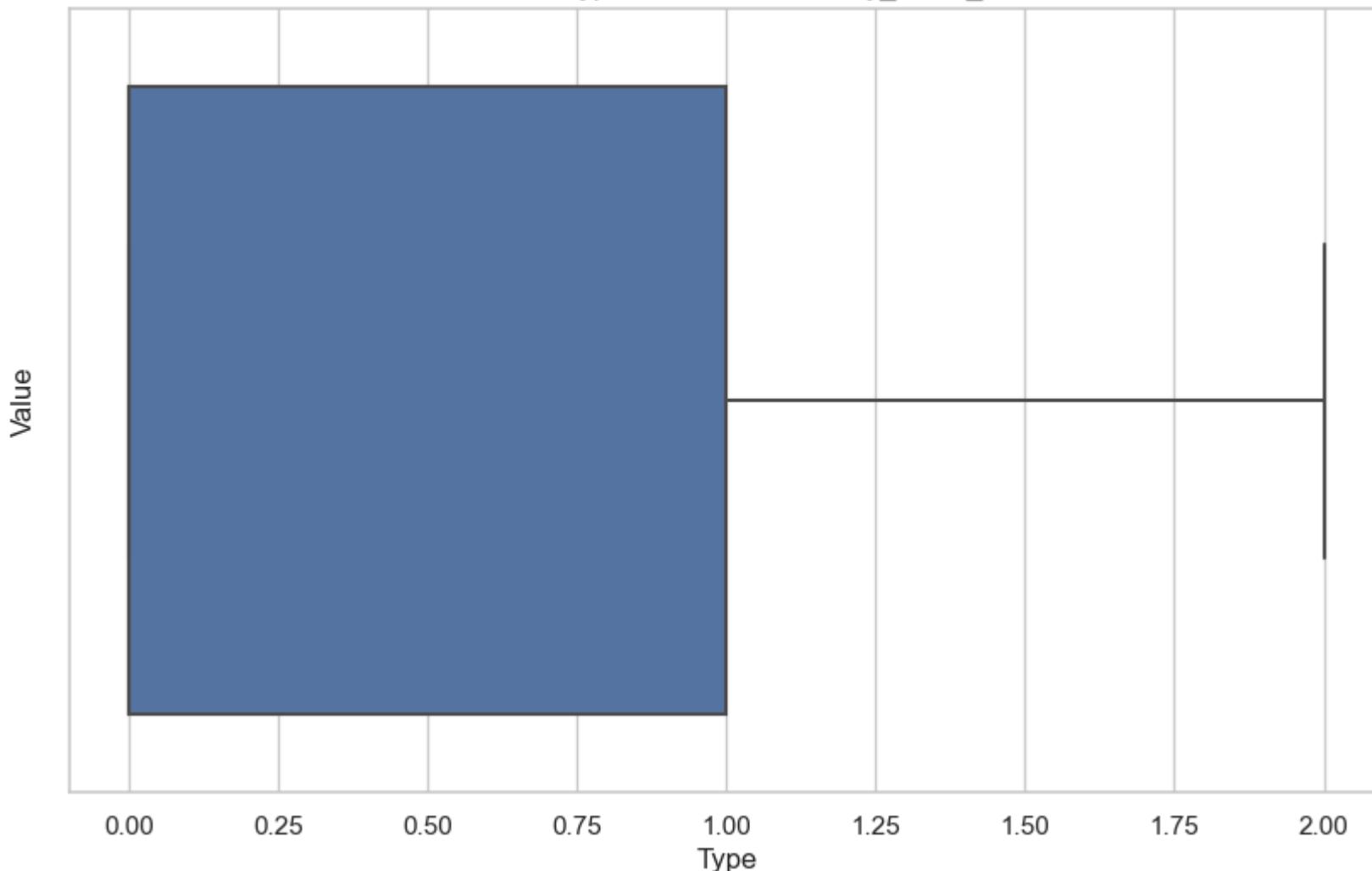


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

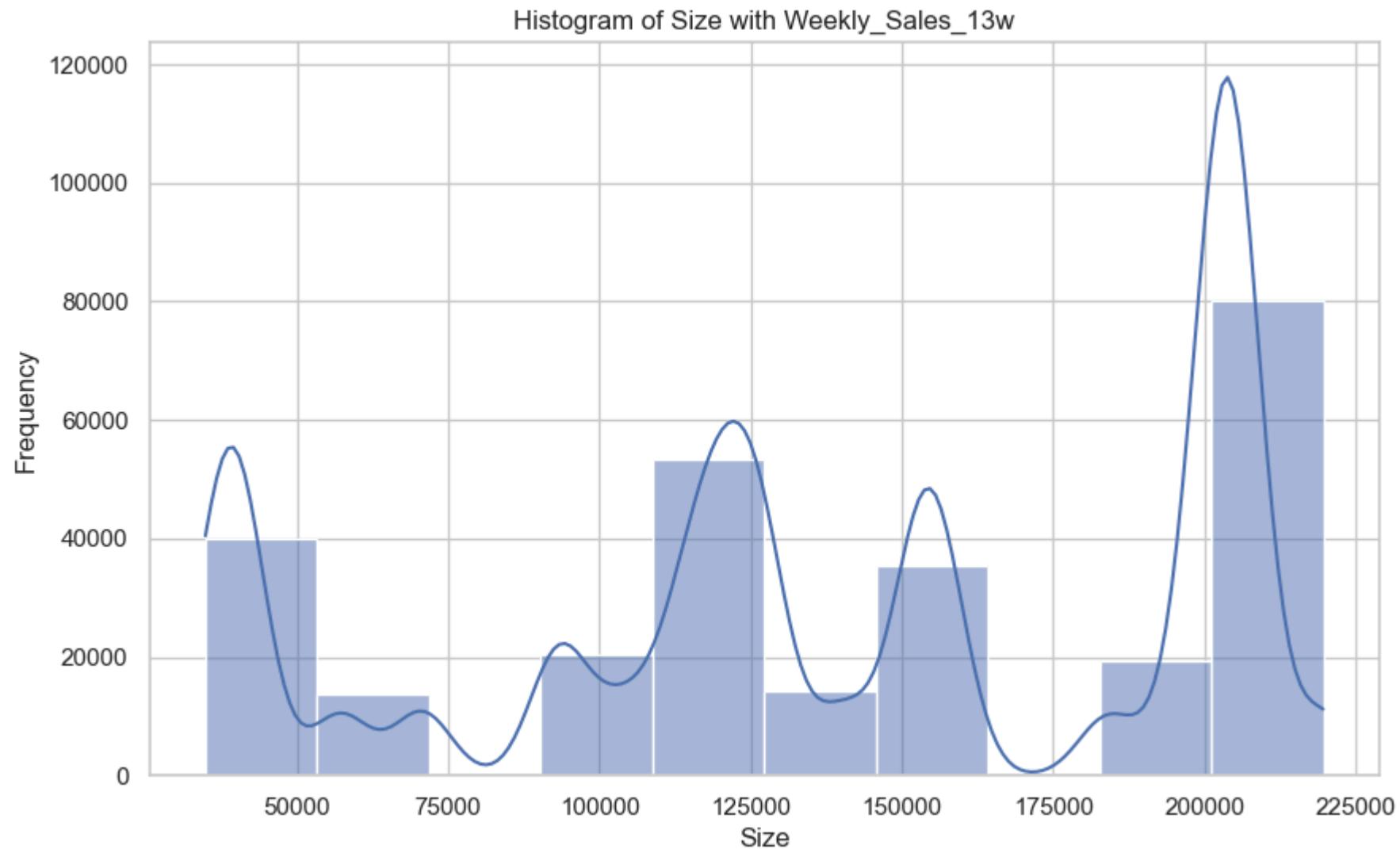
Histogram of Type with Weekly_Sales_13w



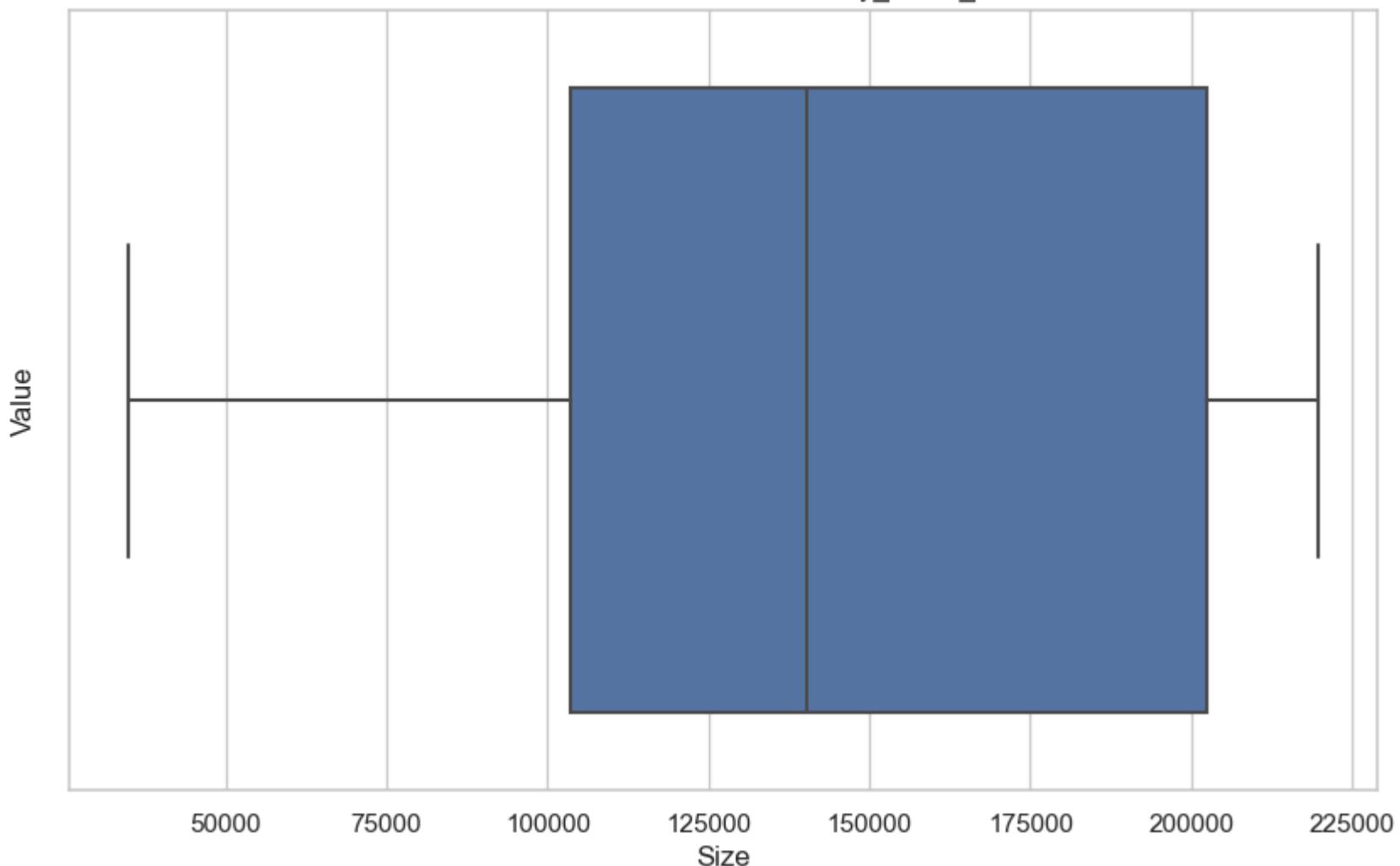
Box Plot of Type in Data with Weekly_Sales_13w



```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

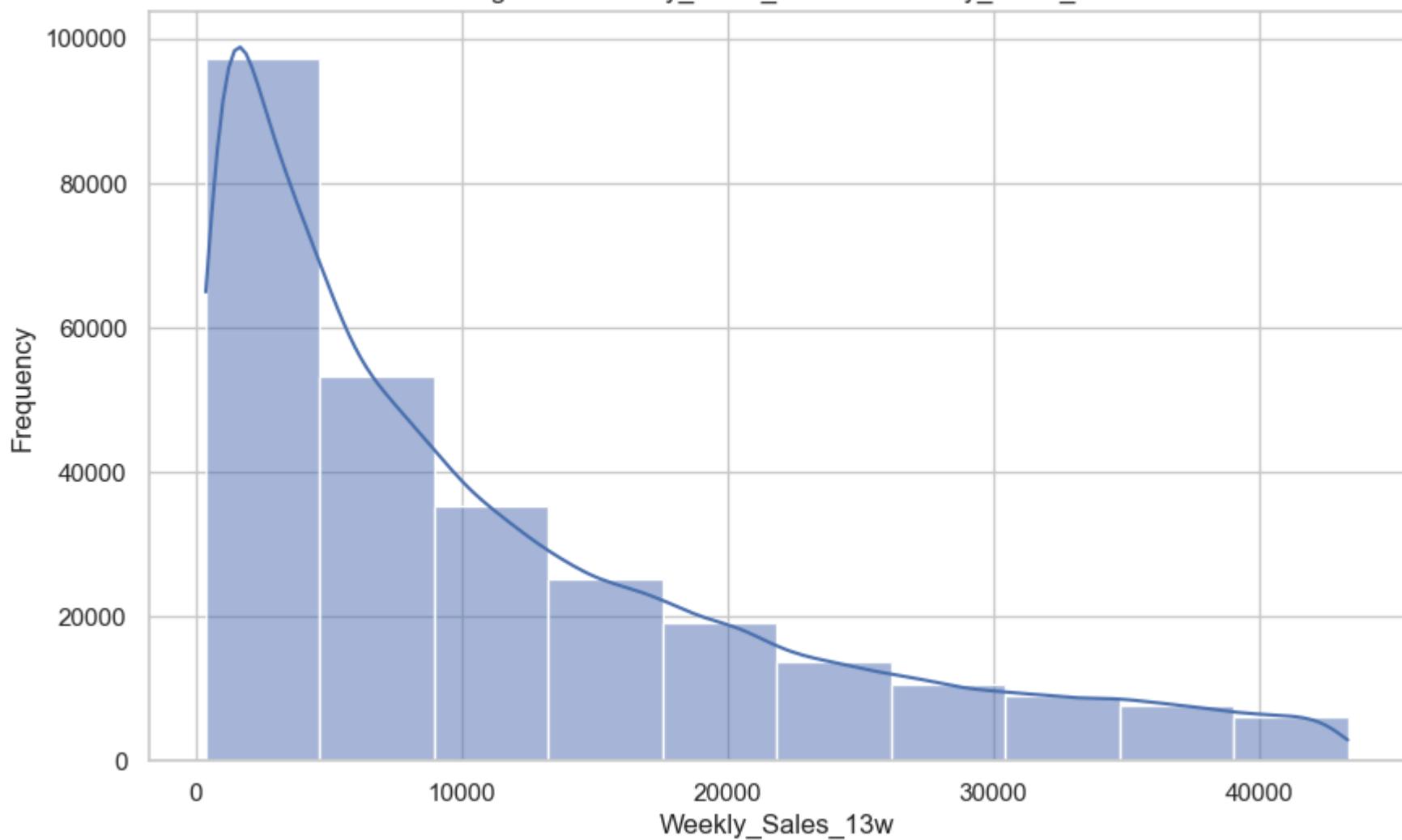


Box Plot of Size in Data with Weekly_Sales_13w

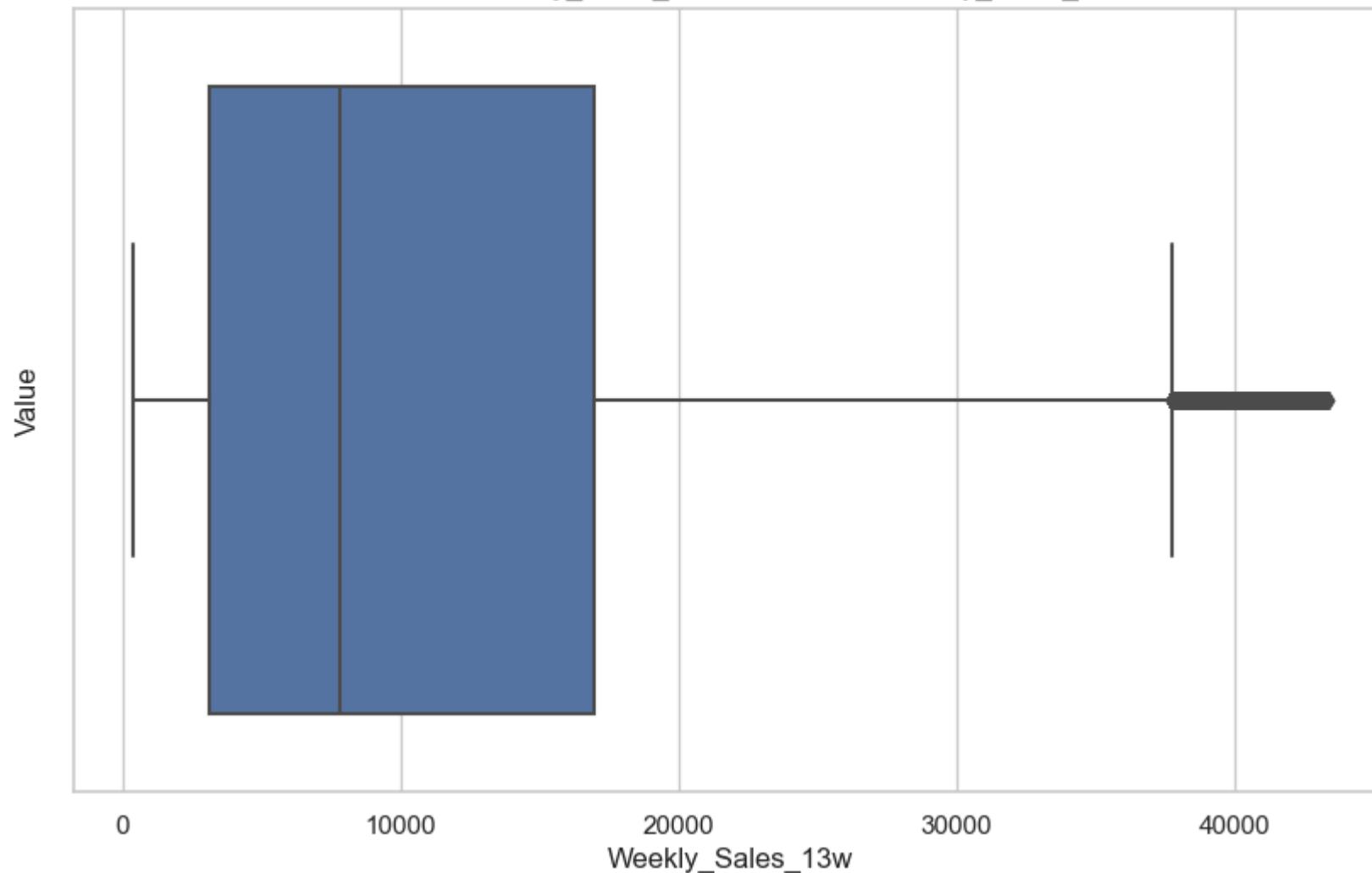


```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.  
with pd.option_context('mode.use_inf_as_na', True):
```

Histogram of Weekly_Sales_13w with Weekly_Sales_13w



Box Plot of Weekly_Sales_13w in Data with Weekly_Sales_13w



5. Identify correlated variables

In [22]:

```
# Correlation coefficient check
for week, df in data_frames.items():
    numerical_df = df.select_dtypes(include=['float64', 'int64'])
    # Calculate the correlation matrix
```

```
correlation = numerical_df.corr(method="spearman")
print(f"Spearman Rank Correlation:\n {correlation}\n")

# Create a heatmap with seaborn
plt.figure(figsize=(10, 10))
sns.heatmap(correlation, annot=True, cmap='coolwarm', fmt=".2f")
plt.title(f'Feature Correlation Matrix Heatmap with {week}')
plt.savefig('Feature Correlation Matrix Heatmap.png', dpi=300)
plt.show()
```

Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025280	-0.009639	-0.000218	-0.086879	
Dept	0.025280	1.000000	-0.083276	-0.000695	0.013433	
Weekly_Sales	-0.009639	-0.083276	1.000000	0.008374	0.014733	
IsHoliday	-0.000218	-0.000695	0.008374	1.000000	-0.163929	
Temperature	-0.086879	0.013433	0.014733	-0.163929	1.000000	
Fuel_Price	0.071548	0.005739	0.012982	-0.076015	0.032419	
MarkDown1	-0.145337	-0.025545	0.066864	-0.116753	-0.027580	
MarkDown2	-0.027408	-0.027085	0.001382	0.170463	-0.290759	
MarkDown3	-0.065622	0.003049	0.094533	0.258746	-0.241310	
MarkDown4	0.008755	-0.003614	0.041363	-0.077544	-0.062560	
MarkDown5	-0.101361	-0.012410	0.088438	-0.084285	-0.121497	
CPI	-0.257109	-0.021685	-0.048119	0.003399	0.154197	
Unemployment	0.310849	0.014977	0.018002	0.002005	0.083295	
Type	0.089246	0.000394	-0.132519	-0.000276	-0.001492	
Size	-0.087508	-0.011061	0.171763	0.000365	-0.008525	
Weekly_Sales_2w	-0.009615	-0.082010	0.975418	-0.007026	0.014717	

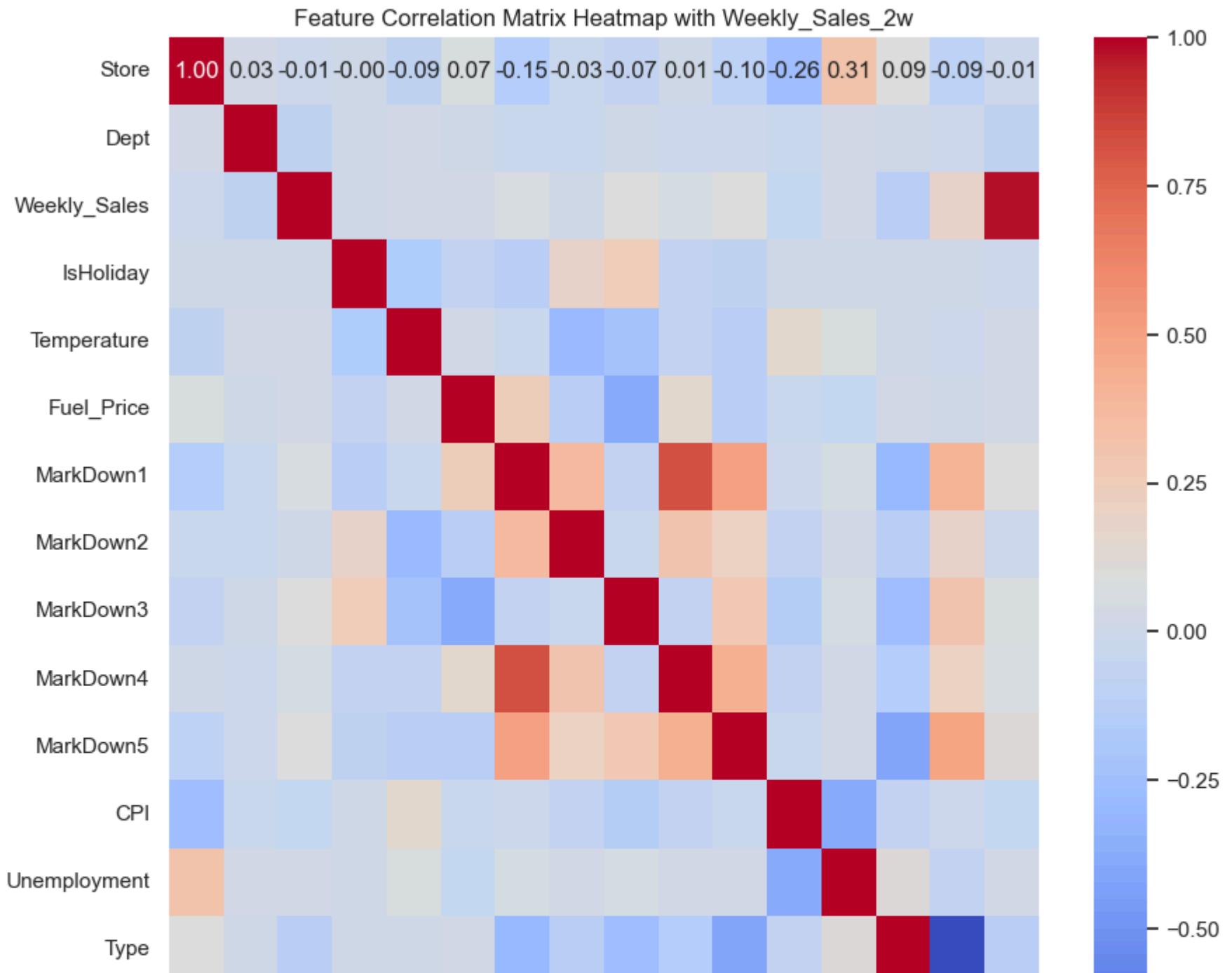
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.071548	-0.145337	-0.027408	-0.065622	0.008755	
Dept	0.005739	-0.025545	-0.027085	0.003049	-0.003614	
Weekly_Sales	0.012982	0.066864	0.001382	0.094533	0.041363	
IsHoliday	-0.076015	-0.116753	0.170463	0.258746	-0.077544	
Temperature	0.032419	-0.027580	-0.290759	-0.241310	-0.062560	
Fuel_Price	1.000000	0.240829	-0.126156	-0.383134	0.148522	
MarkDown1	0.240829	1.000000	0.365543	-0.053459	0.822954	
MarkDown2	-0.126156	0.365543	1.000000	-0.034868	0.298093	
MarkDown3	-0.383134	-0.053459	-0.034868	1.000000	-0.074392	
MarkDown4	0.148522	0.822954	0.298093	-0.074392	1.000000	
MarkDown5	-0.124085	0.501525	0.202312	0.262466	0.437924	
CPI	-0.031848	-0.004597	-0.059231	-0.139582	-0.058879	
Unemployment	-0.048611	0.045558	0.018069	0.042369	0.032144	
Type	0.032665	-0.300762	-0.117094	-0.261303	-0.145358	
Size	0.011657	0.403653	0.173614	0.298882	0.216801	
Weekly_Sales_2w	0.014972	0.090115	-0.012789	0.077323	0.062895	

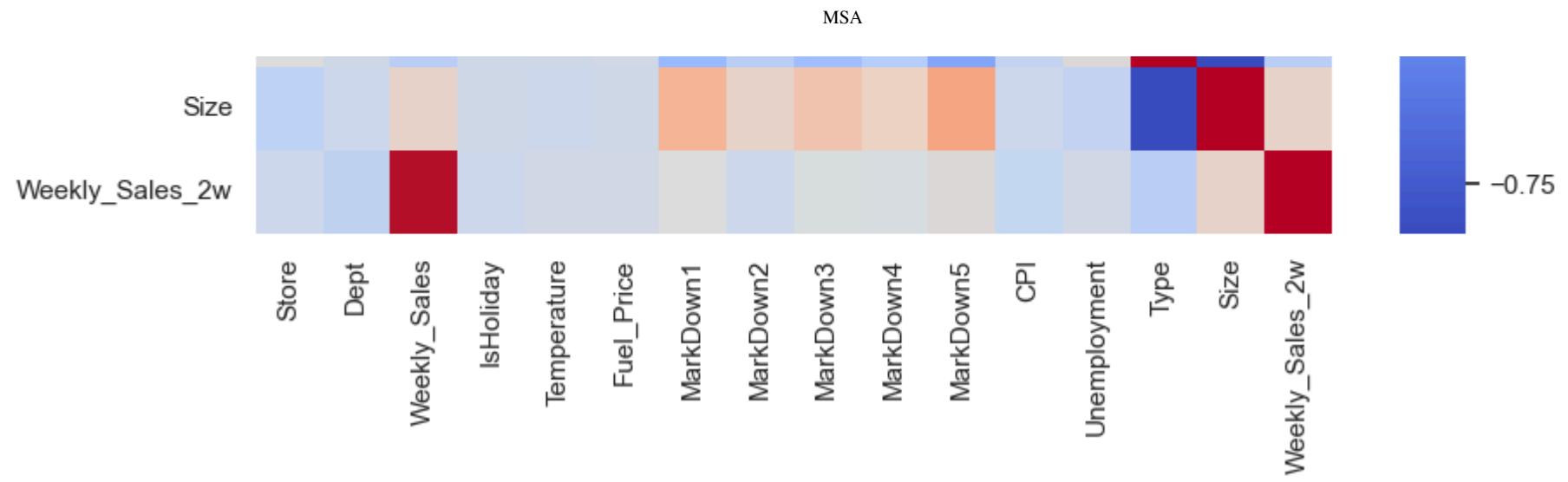
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.101361	-0.257109	0.310849	0.089246	-0.087508	
Dept	-0.012410	-0.021685	0.014977	0.000394	-0.011061	
Weekly_Sales	0.088438	-0.048119	0.018002	-0.132519	0.171763	

IsHoliday	-0.084285	0.003399	0.002005	-0.000276	0.000365
Temperature	-0.121497	0.154197	0.083295	-0.001492	-0.008525
Fuel_Price	-0.124085	-0.031848	-0.048611	0.032665	0.011657
MarkDown1	0.501525	-0.004597	0.045558	-0.300762	0.403653
MarkDown2	0.202312	-0.059231	0.018069	-0.117094	0.173614
MarkDown3	0.262466	-0.139582	0.042369	-0.261303	0.298882
MarkDown4	0.437924	-0.058879	0.032144	-0.145358	0.216801
MarkDown5	1.000000	-0.026919	0.017930	-0.395438	0.493996
CPI	-0.026919	1.000000	-0.386735	-0.076035	-0.015731
Unemployment	0.017930	-0.386735	1.000000	0.110101	-0.058567
Type	-0.395438	-0.076035	0.110101	1.000000	-0.819123
Size	0.493996	-0.015731	-0.058567	-0.819123	1.000000
Weekly_Sales_2w	0.110002	-0.047985	0.017301	-0.132624	0.171909

Weekly_Sales_2w

Store	-0.009615
Dept	-0.082010
Weekly_Sales	0.975418
IsHoliday	-0.007026
Temperature	0.014717
Fuel_Price	0.014972
MarkDown1	0.090115
MarkDown2	-0.012789
MarkDown3	0.077323
MarkDown4	0.062895
MarkDown5	0.110002
CPI	-0.047985
Unemployment	0.017301
Type	-0.132624
Size	0.171909
Weekly_Sales_2w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025379	-0.009738	-0.000325	-0.086900	
Dept	0.025379	1.000000	-0.083235	-0.000578	0.013503	
Weekly_Sales	-0.009738	-0.083235	1.000000	0.010421	0.013959	
IsHoliday	-0.000325	-0.000578	0.010421	1.000000	-0.163641	
Temperature	-0.086900	0.013503	0.013959	-0.163641	1.000000	
Fuel_Price	0.071561	0.006023	0.012641	-0.075417	0.031904	
MarkDown1	-0.144321	-0.022786	0.068575	-0.112036	-0.030129	
MarkDown2	-0.028101	-0.022852	-0.008238	0.176048	-0.292481	
MarkDown3	-0.065842	0.002718	0.096114	0.257233	-0.241932	
MarkDown4	0.011457	0.000639	0.035618	-0.070559	-0.062711	
MarkDown5	-0.102064	-0.013258	0.090277	-0.081227	-0.120966	
CPI	-0.257250	-0.021646	-0.048196	0.004278	0.154144	
Unemployment	0.310841	0.014909	0.018290	0.002017	0.083180	
Type	0.089205	0.000254	-0.132403	-0.001700	-0.001624	
Size	-0.087459	-0.011019	0.171555	0.001329	-0.008546	
Weekly_Sales_3w	-0.009407	-0.081565	0.961842	-0.013702	0.014515	

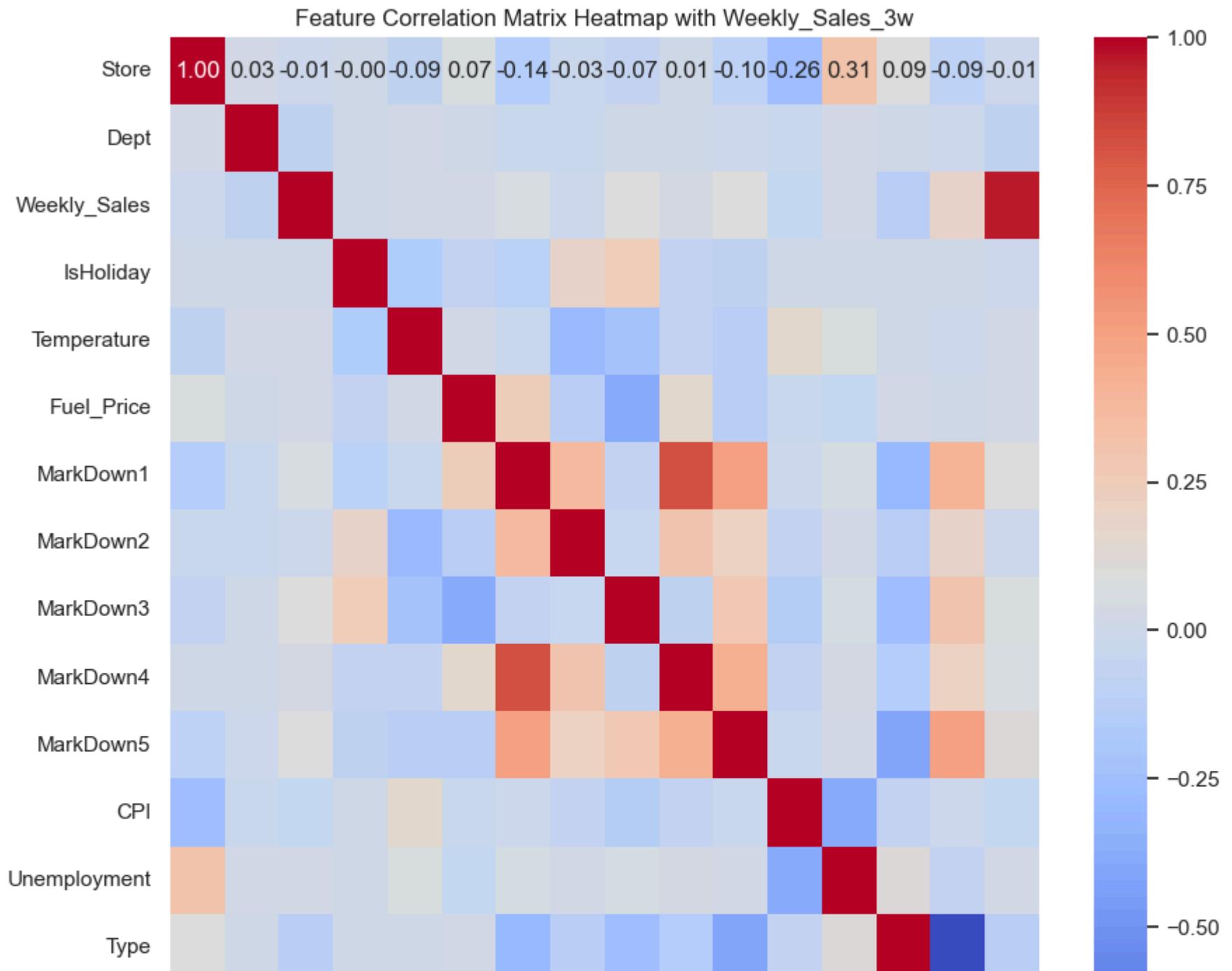
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.071561	-0.144321	-0.028101	-0.065842	0.011457	
Dept	0.006023	-0.022786	-0.022852	0.002718	0.000639	
Weekly_Sales	0.012641	0.068575	-0.008238	0.096114	0.035618	
IsHoliday	-0.075417	-0.112036	0.176048	0.257233	-0.070559	
Temperature	0.031904	-0.030129	-0.292481	-0.241932	-0.062711	
Fuel_Price	1.000000	0.242352	-0.125484	-0.383837	0.153869	
MarkDown1	0.242352	1.000000	0.363743	-0.056249	0.822121	
MarkDown2	-0.125484	0.363743	1.000000	-0.038809	0.299250	
MarkDown3	-0.383837	-0.056249	-0.038809	1.000000	-0.081500	
MarkDown4	0.153869	0.822121	0.299250	-0.081500	1.000000	
MarkDown5	-0.122425	0.500701	0.201590	0.261299	0.434072	
CPI	-0.031874	-0.004210	-0.058744	-0.139467	-0.059804	
Unemployment	-0.048503	0.045959	0.016944	0.042878	0.033636	
Type	0.032761	-0.301476	-0.117627	-0.262347	-0.144334	
Size	0.011526	0.404720	0.173157	0.299670	0.215790	
Weekly_Sales_3w	0.016239	0.093752	-0.003621	0.073146	0.068333	

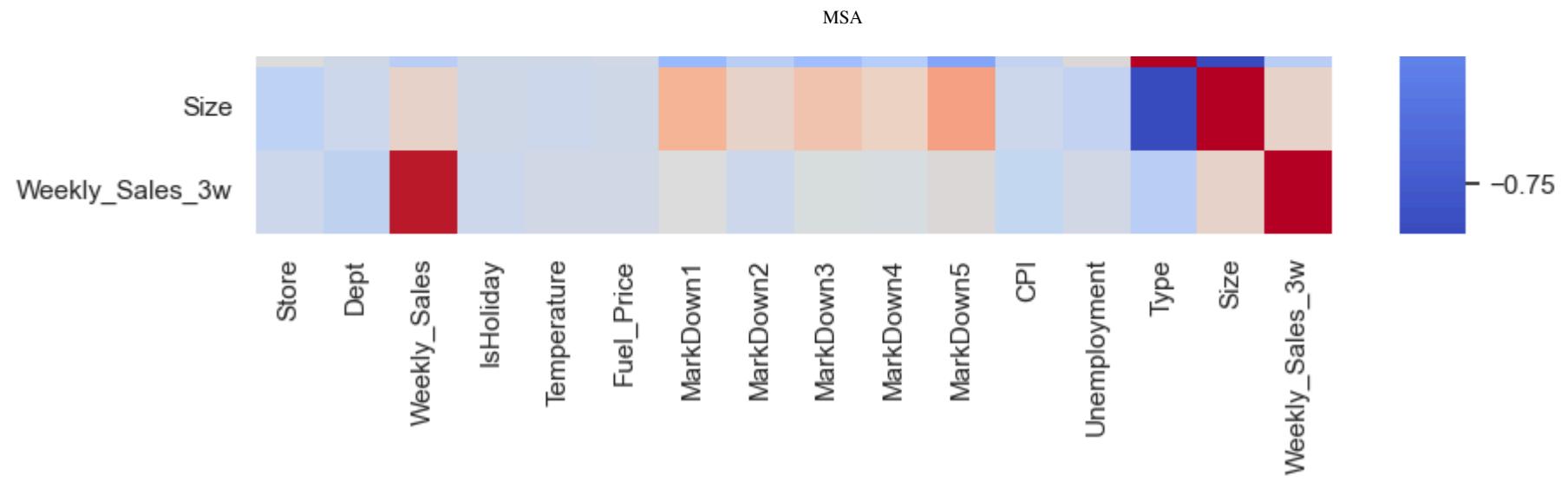
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.102064	-0.257250	0.310841	0.089205	-0.087459	
Dept	-0.013258	-0.021646	0.014909	0.000254	-0.011019	
Weekly_Sales	0.090277	-0.048196	0.018290	-0.132403	0.171555	

IsHoliday	-0.081227	0.004278	0.002017	-0.001700	0.001329
Temperature	-0.120966	0.154144	0.083180	-0.001624	-0.008546
Fuel_Price	-0.122425	-0.031874	-0.048503	0.032761	0.011526
MarkDown1	0.500701	-0.004210	0.045959	-0.301476	0.404720
MarkDown2	0.201590	-0.058744	0.016944	-0.117627	0.173157
MarkDown3	0.261299	-0.139467	0.042878	-0.262347	0.299670
MarkDown4	0.434072	-0.059804	0.033636	-0.144334	0.215790
MarkDown5	1.000000	-0.026958	0.017352	-0.396118	0.495797
CPI	-0.026958	1.000000	-0.386784	-0.075951	-0.015787
Unemployment	0.017352	-0.386784	1.000000	0.109971	-0.058357
Type	-0.396118	-0.075951	0.109971	1.000000	-0.819075
Size	0.495797	-0.015787	-0.058357	-0.819075	1.000000
Weekly_Sales_3w	0.109379	-0.047764	0.016768	-0.132618	0.171891

Weekly_Sales_3w

Store	-0.009407
Dept	-0.081565
Weekly_Sales	0.961842
IsHoliday	-0.013702
Temperature	0.014515
Fuel_Price	0.016239
MarkDown1	0.093752
MarkDown2	-0.003621
MarkDown3	0.073146
MarkDown4	0.068333
MarkDown5	0.109379
CPI	-0.047764
Unemployment	0.016768
Type	-0.132618
Size	0.171891
Weekly_Sales_3w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025514	-0.009685	-0.000461	-0.086755	
Dept	0.025514	1.000000	-0.083505	0.000759	0.013503	
Weekly_Sales	-0.009685	-0.083505	1.000000	0.005313	0.012006	
IsHoliday	-0.000461	0.000759	0.005313	1.000000	-0.162303	
Temperature	-0.086755	0.013503	0.012006	-0.162303	1.000000	
Fuel_Price	0.071447	0.006136	0.012205	-0.074905	0.031666	
MarkDown1	-0.144809	-0.023866	0.075326	-0.112266	-0.031350	
MarkDown2	-0.026874	-0.020541	-0.012613	0.176699	-0.291031	
MarkDown3	-0.066953	-0.000430	0.101649	0.254714	-0.244515	
MarkDown4	0.010713	-0.003500	0.045191	-0.070284	-0.065464	
MarkDown5	-0.102568	-0.017168	0.099321	-0.082433	-0.123662	
CPI	-0.257345	-0.021512	-0.048110	0.004132	0.153986	
Unemployment	0.310750	0.014853	0.018455	0.001810	0.083152	
Type	0.089217	0.000251	-0.132470	-0.000564	-0.001512	
Size	-0.087433	-0.011050	0.171563	0.000180	-0.008758	
Weekly_Sales_4w	-0.009202	-0.081164	0.951904	-0.008377	0.014296	

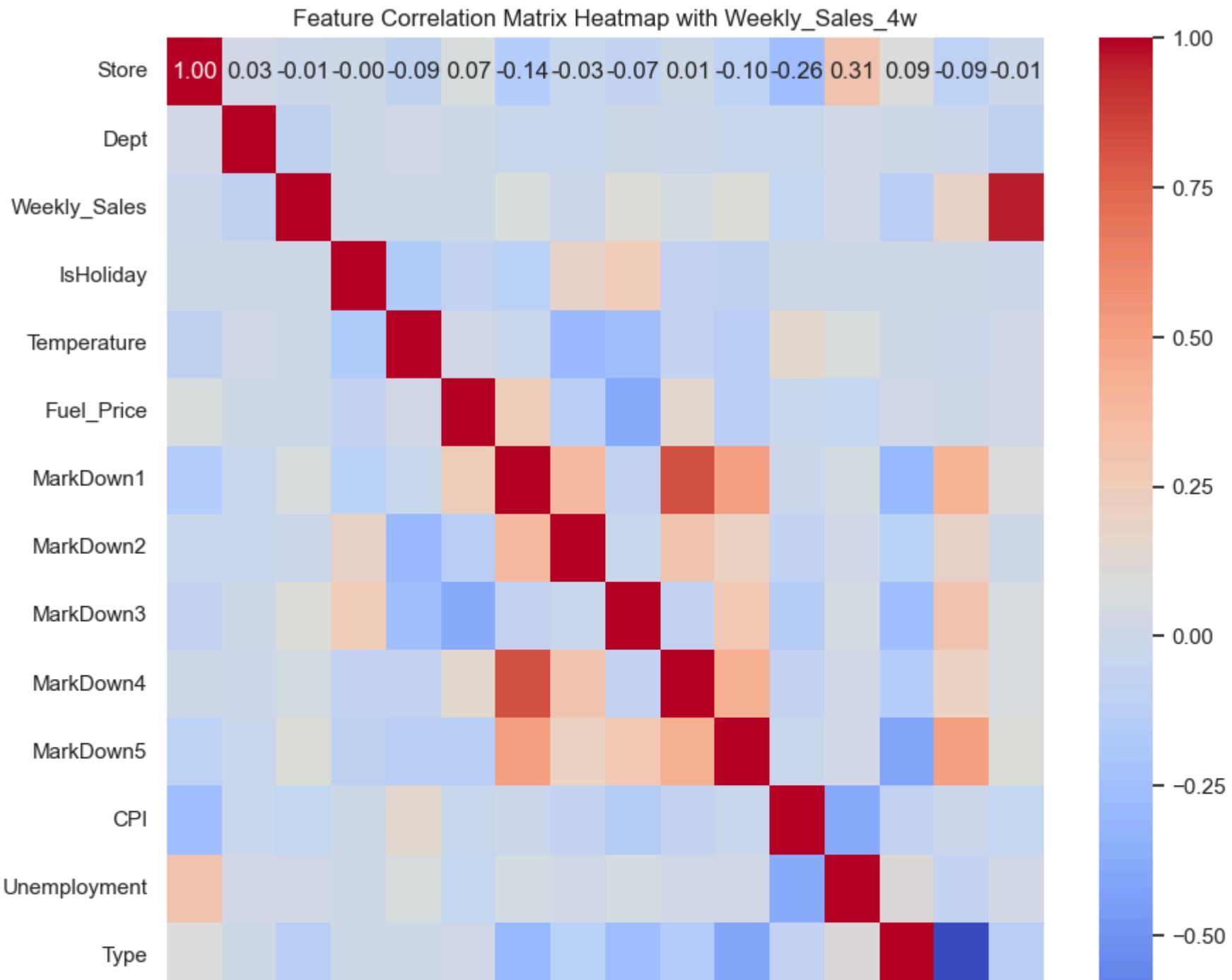
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.071447	-0.144809	-0.026874	-0.066953	0.010713	
Dept	0.006136	-0.023866	-0.020541	-0.000430	-0.003500	
Weekly_Sales	0.012205	0.075326	-0.012613	0.101649	0.045191	
IsHoliday	-0.074905	-0.112266	0.176699	0.254714	-0.070284	
Temperature	0.031666	-0.031350	-0.291031	-0.244515	-0.065464	
Fuel_Price	1.000000	0.239864	-0.125155	-0.385398	0.150463	
MarkDown1	0.239864	1.000000	0.364347	-0.052686	0.821831	
MarkDown2	-0.125155	0.364347	1.000000	-0.037410	0.300657	
MarkDown3	-0.385398	-0.052686	-0.037410	1.000000	-0.076926	
MarkDown4	0.150463	0.821831	0.300657	-0.076926	1.000000	
MarkDown5	-0.123590	0.500892	0.199584	0.263209	0.435481	
CPI	-0.031819	-0.004811	-0.059265	-0.140428	-0.059936	
Unemployment	-0.048629	0.046113	0.016592	0.042751	0.033234	
Type	0.032905	-0.302046	-0.115381	-0.262905	-0.144034	
Size	0.011342	0.405260	0.171464	0.300421	0.216372	
Weekly_Sales_4w	0.017637	0.086290	0.010535	0.060246	0.061557	

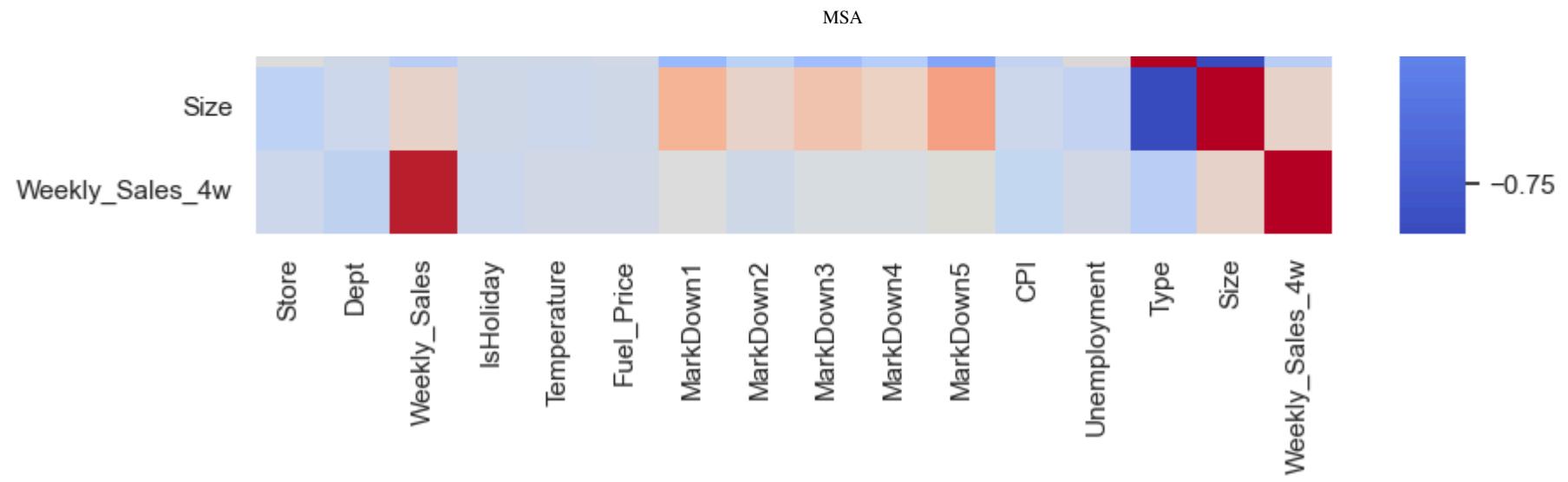
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.102568	-0.257345	0.310750	0.089217	-0.087433	
Dept	-0.017168	-0.021512	0.014853	0.000251	-0.011050	
Weekly_Sales	0.099321	-0.048110	0.018455	-0.132470	0.171563	

IsHoliday	-0.082433	0.004132	0.001810	-0.000564	0.000180
Temperature	-0.123662	0.153986	0.083152	-0.001512	-0.008758
Fuel_Price	-0.123590	-0.031819	-0.048629	0.032905	0.011342
MarkDown1	0.500892	-0.004811	0.046113	-0.302046	0.405260
MarkDown2	0.199584	-0.059265	0.016592	-0.115381	0.171464
MarkDown3	0.263209	-0.140428	0.042751	-0.262905	0.300421
MarkDown4	0.435481	-0.059936	0.033234	-0.144034	0.216372
MarkDown5	1.000000	-0.028120	0.017281	-0.397092	0.497384
CPI	-0.028120	1.000000	-0.386882	-0.075821	-0.015887
Unemployment	0.017281	-0.386882	1.000000	0.109920	-0.058264
Type	-0.397092	-0.075821	0.109920	1.000000	-0.819050
Size	0.497384	-0.015887	-0.058264	-0.819050	1.000000
Weekly_Sales_4w	0.102756	-0.047374	0.015972	-0.132624	0.171863

Weekly_Sales_4w

Store	-0.009202
Dept	-0.081164
Weekly_Sales	0.951904
IsHoliday	-0.008377
Temperature	0.014296
Fuel_Price	0.017637
MarkDown1	0.086290
MarkDown2	0.010535
MarkDown3	0.060246
MarkDown4	0.061557
MarkDown5	0.102756
CPI	-0.047374
Unemployment	0.015972
Type	-0.132624
Size	0.171863
Weekly_Sales_4w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025427	-0.009661	-0.000075	-0.086554	
Dept	0.025427	1.000000	-0.084232	0.000702	0.013682	
Weekly_Sales	-0.009661	-0.084232	1.000000	-0.000578	0.010402	
IsHoliday	-0.000075	0.000702	-0.000578	1.000000	-0.162821	
Temperature	-0.086554	0.013682	0.010402	-0.162821	1.000000	
Fuel_Price	0.071322	0.006150	0.011489	-0.074776	0.032005	
MarkDown1	-0.144601	-0.023106	0.073914	-0.103141	-0.031585	
MarkDown2	-0.025739	-0.016789	-0.024458	0.185519	-0.289950	
MarkDown3	-0.066279	-0.004994	0.105828	0.243914	-0.245745	
MarkDown4	0.012130	-0.005054	0.051351	-0.060890	-0.065044	
MarkDown5	-0.101666	-0.020938	0.107931	-0.078853	-0.125190	
CPI	-0.257459	-0.021454	-0.048028	0.004033	0.153651	
Unemployment	0.310753	0.014774	0.018670	0.001960	0.083012	
Type	0.089186	0.000235	-0.132369	0.001150	-0.001467	
Size	-0.087313	-0.011063	0.171431	-0.001322	-0.008877	
Weekly_Sales_5w	-0.009118	-0.081086	0.945227	-0.000521	0.013691	

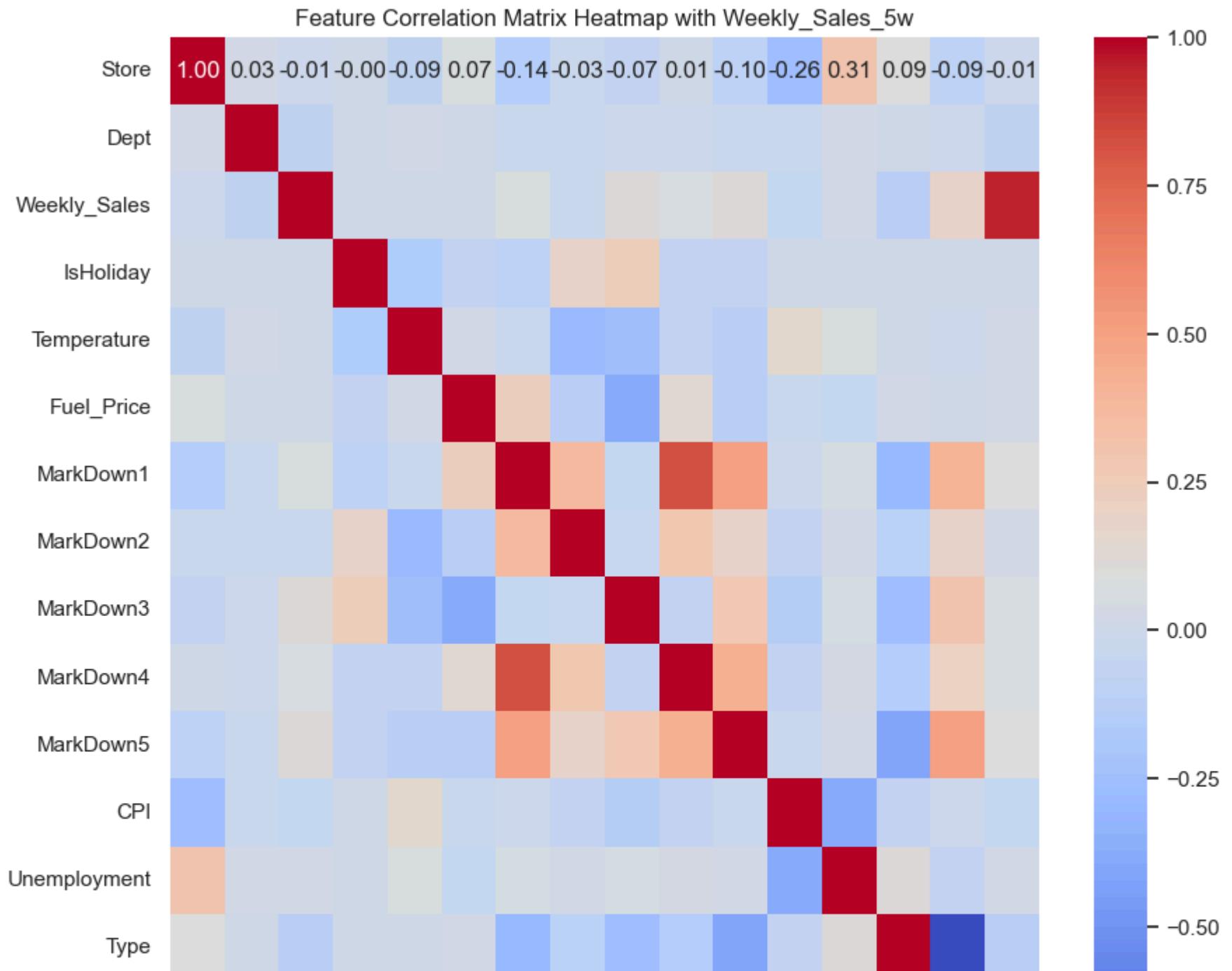
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.071322	-0.144601	-0.025739	-0.066279	0.012130	
Dept	0.006150	-0.023106	-0.016789	-0.004994	-0.005054	
Weekly_Sales	0.011489	0.073914	-0.024458	0.105828	0.051351	
IsHoliday	-0.074776	-0.103141	0.185519	0.243914	-0.060890	
Temperature	0.032005	-0.031585	-0.289950	-0.245745	-0.065044	
Fuel_Price	1.000000	0.238785	-0.122891	-0.386088	0.146293	
MarkDown1	0.238785	1.000000	0.361156	-0.048295	0.819919	
MarkDown2	-0.122891	0.361156	1.000000	-0.042315	0.291714	
MarkDown3	-0.386088	-0.048295	-0.042315	1.000000	-0.066814	
MarkDown4	0.146293	0.819919	0.291714	-0.066814	1.000000	
MarkDown5	-0.127855	0.498338	0.190428	0.274722	0.437783	
CPI	-0.031885	-0.005594	-0.056887	-0.141073	-0.062158	
Unemployment	-0.048500	0.046474	0.017774	0.042642	0.033717	
Type	0.033086	-0.301584	-0.113411	-0.262015	-0.144998	
Size	0.011209	0.405365	0.168760	0.300621	0.217071	
Weekly_Sales_5w	0.018413	0.088508	0.033612	0.053418	0.054328	

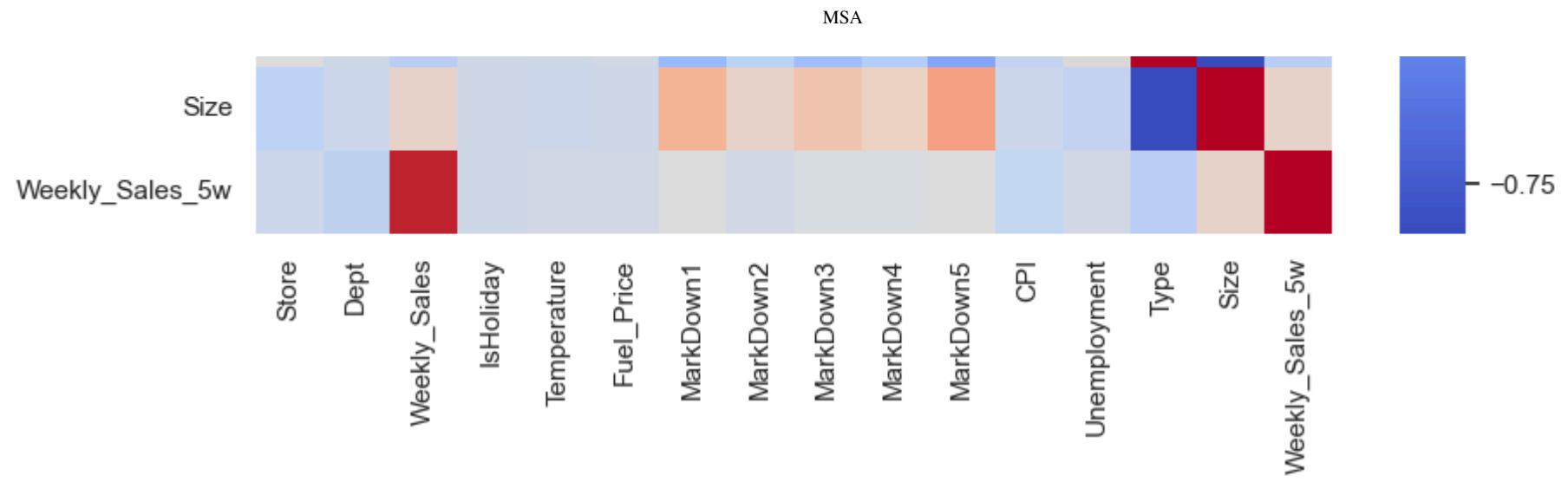
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.101666	-0.257459	0.310753	0.089186	-0.087313	
Dept	-0.020938	-0.021454	0.014774	0.000235	-0.011063	
Weekly_Sales	0.107931	-0.048028	0.018670	-0.132369	0.171431	

IsHoliday	-0.078853	0.004033	0.001960	0.001150	-0.001322
Temperature	-0.125190	0.153651	0.083012	-0.001467	-0.008877
Fuel_Price	-0.127855	-0.031885	-0.048500	0.033086	0.011209
MarkDown1	0.498338	-0.005594	0.046474	-0.301584	0.405365
MarkDown2	0.190428	-0.056887	0.017774	-0.113411	0.168760
MarkDown3	0.274722	-0.141073	0.042642	-0.262015	0.300621
MarkDown4	0.437783	-0.062158	0.033717	-0.144998	0.217071
MarkDown5	1.000000	-0.029855	0.018462	-0.396791	0.496772
CPI	-0.029855	1.000000	-0.386993	-0.075815	-0.015945
Unemployment	0.018462	-0.386993	1.000000	0.109884	-0.058145
Type	-0.396791	-0.075815	0.109884	1.000000	-0.819018
Size	0.496772	-0.015945	-0.058145	-0.819018	1.000000
Weekly_Sales_5w	0.093170	-0.047098	0.015520	-0.132685	0.171806

Weekly_Sales_5w

Store	-0.009118
Dept	-0.081086
Weekly_Sales	0.945227
IsHoliday	-0.000521
Temperature	0.013691
Fuel_Price	0.018413
MarkDown1	0.088508
MarkDown2	0.033612
MarkDown3	0.053418
MarkDown4	0.054328
MarkDown5	0.093170
CPI	-0.047098
Unemployment	0.015520
Type	-0.132685
Size	0.171806
Weekly_Sales_5w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025449	-0.009669	0.000287	-0.086726	
Dept	0.025449	1.000000	-0.084982	-0.003092	0.013508	
Weekly_Sales	-0.009669	-0.084982	1.000000	0.014056	0.009086	
IsHoliday	0.000287	-0.003092	0.014056	1.000000	-0.164583	
Temperature	-0.086726	0.013508	0.009086	-0.164583	1.000000	
Fuel_Price	0.071224	0.006101	0.011186	-0.075750	0.032016	
MarkDown1	-0.144556	-0.018813	0.059695	-0.115002	-0.030526	
MarkDown2	-0.023689	-0.010842	-0.040198	0.174743	-0.289790	
MarkDown3	-0.065656	-0.010577	0.116365	0.256363	-0.243584	
MarkDown4	0.011089	-0.001720	0.040631	-0.075260	-0.062898	
MarkDown5	-0.100387	-0.018674	0.100238	-0.085005	-0.126114	
CPI	-0.257476	-0.021516	-0.047935	0.002768	0.154046	
Unemployment	0.310769	0.014765	0.018843	0.002318	0.082834	
Type	0.089104	0.000173	-0.132330	-0.001069	-0.001859	
Size	-0.087308	-0.011047	0.171423	0.000957	-0.008704	
Weekly_Sales_6w	-0.009020	-0.080800	0.935790	-0.008889	0.011596	

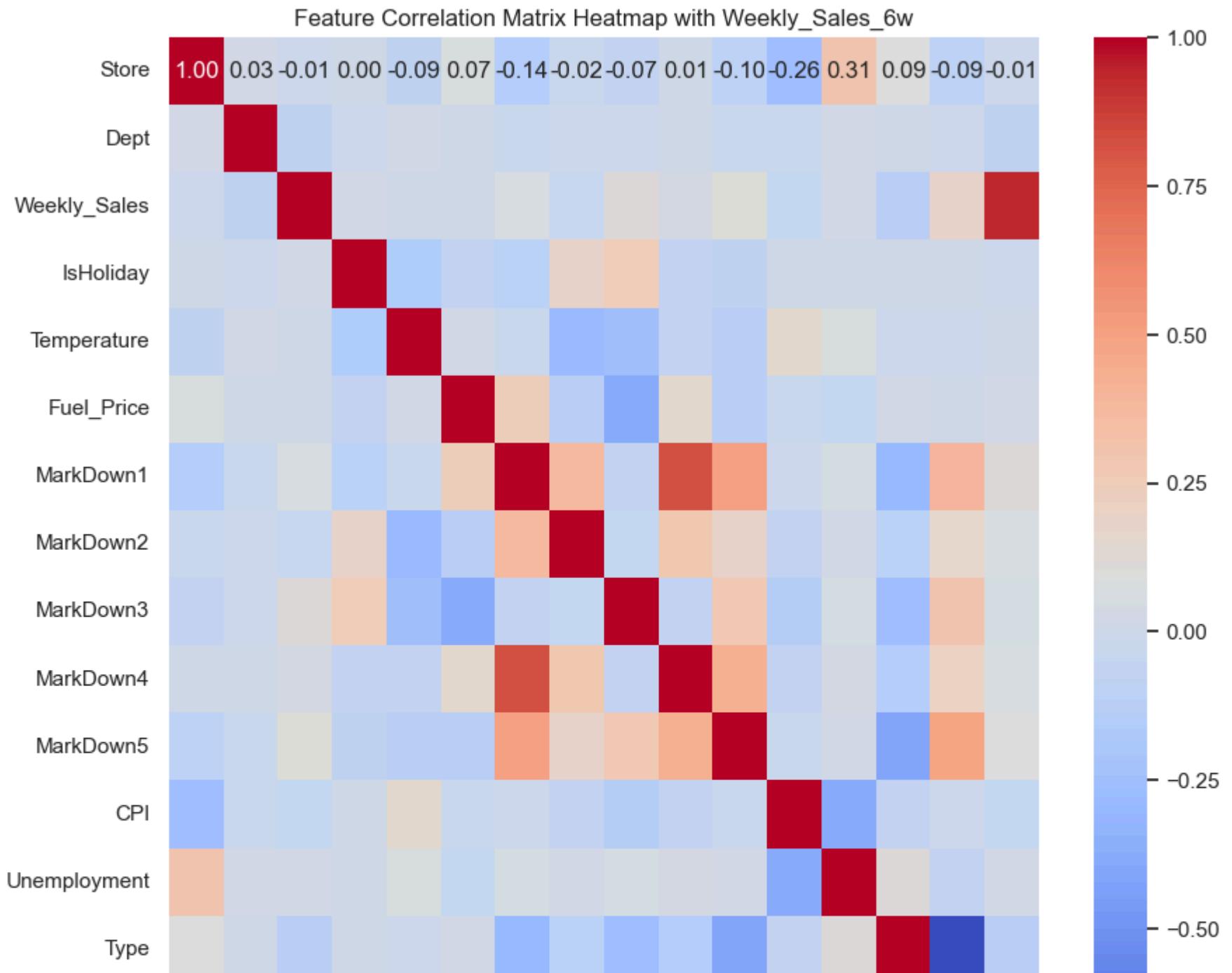
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.071224	-0.144556	-0.023689	-0.065656	0.011089	
Dept	0.006101	-0.018813	-0.010842	-0.010577	-0.001720	
Weekly_Sales	0.011186	0.059695	-0.040198	0.116365	0.040631	
IsHoliday	-0.075750	-0.115002	0.174743	0.256363	-0.075260	
Temperature	0.032016	-0.030526	-0.289790	-0.243584	-0.062898	
Fuel_Price	1.000000	0.241437	-0.121339	-0.385615	0.149599	
MarkDown1	0.241437	1.000000	0.362483	-0.058150	0.822166	
MarkDown2	-0.121339	0.362483	1.000000	-0.049405	0.294053	
MarkDown3	-0.385615	-0.058150	-0.049405	1.000000	-0.076732	
MarkDown4	0.149599	0.822166	0.294053	-0.076732	1.000000	
MarkDown5	-0.124968	0.501007	0.193153	0.264517	0.442071	
CPI	-0.031769	-0.003801	-0.054860	-0.142324	-0.060032	
Unemployment	-0.048482	0.045320	0.018502	0.042649	0.033767	
Type	0.033091	-0.298868	-0.110637	-0.261711	-0.145192	
Size	0.011177	0.402004	0.164705	0.300562	0.215993	
Weekly_Sales_6w	0.019224	0.105199	0.058724	0.041566	0.066346	

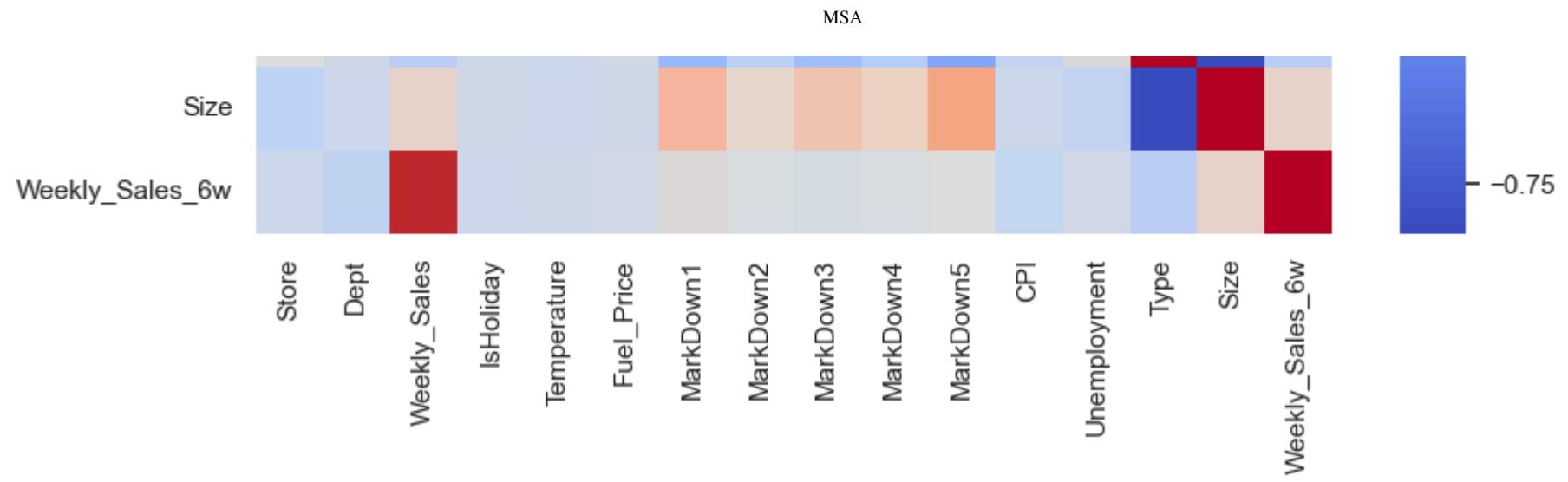
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.100387	-0.257476	0.310769	0.089104	-0.087308	
Dept	-0.018674	-0.021516	0.014765	0.000173	-0.011047	
Weekly_Sales	0.100238	-0.047935	0.018843	-0.132330	0.171423	

IsHoliday	-0.085005	0.002768	0.002318	-0.001069	0.000957
Temperature	-0.126114	0.154046	0.082834	-0.001859	-0.008704
Fuel_Price	-0.124968	-0.031769	-0.048482	0.033091	0.011177
MarkDown1	0.501007	-0.003801	0.045320	-0.298868	0.402004
MarkDown2	0.193153	-0.054860	0.018502	-0.110637	0.164705
MarkDown3	0.264517	-0.142324	0.042649	-0.261711	0.300562
MarkDown4	0.442071	-0.060032	0.033767	-0.145192	0.215993
MarkDown5	1.000000	-0.028800	0.018584	-0.394816	0.494780
CPI	-0.028800	1.000000	-0.387080	-0.075838	-0.015901
Unemployment	0.018584	-0.387080	1.000000	0.109949	-0.058127
Type	-0.394816	-0.075838	0.109949	1.000000	-0.818927
Size	0.494780	-0.015901	-0.058127	-0.818927	1.000000
Weekly_Sales_6w	0.094057	-0.046926	0.015141	-0.132511	0.171667

Weekly_Sales_6w

Store	-0.009020
Dept	-0.080800
Weekly_Sales	0.935790
IsHoliday	-0.008889
Temperature	0.011596
Fuel_Price	0.019224
MarkDown1	0.105199
MarkDown2	0.058724
MarkDown3	0.041566
MarkDown4	0.066346
MarkDown5	0.094057
CPI	-0.046926
Unemployment	0.015141
Type	-0.132511
Size	0.171667
Weekly_Sales_6w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025418	-0.009679	-0.000390	-0.086620	
Dept	0.025418	1.000000	-0.085147	-0.003148	0.013342	
Weekly_Sales	-0.009679	-0.085147	1.000000	0.013215	0.008051	
IsHoliday	-0.000390	-0.003148	0.013215	1.000000	-0.165244	
Temperature	-0.086620	0.013342	0.008051	-0.165244	1.000000	
Fuel_Price	0.071141	0.006045	0.011365	-0.075937	0.032407	
MarkDown1	-0.144947	-0.017007	0.062277	-0.113993	-0.029543	
MarkDown2	-0.023186	-0.006732	-0.049638	0.175969	-0.292609	
MarkDown3	-0.066454	-0.011691	0.117479	0.256435	-0.242815	
MarkDown4	0.010946	0.002762	0.040731	-0.075263	-0.063016	
MarkDown5	-0.100120	-0.018963	0.107066	-0.083920	-0.124226	
CPI	-0.257621	-0.021556	-0.047909	0.003539	0.153822	
Unemployment	0.310773	0.014710	0.018847	0.001775	0.082816	
Type	0.089133	0.000229	-0.132492	-0.001762	-0.001969	
Size	-0.087349	-0.011130	0.171606	0.001644	-0.008664	
Weekly_Sales_7w	-0.008953	-0.080418	0.931109	-0.011865	0.009968	

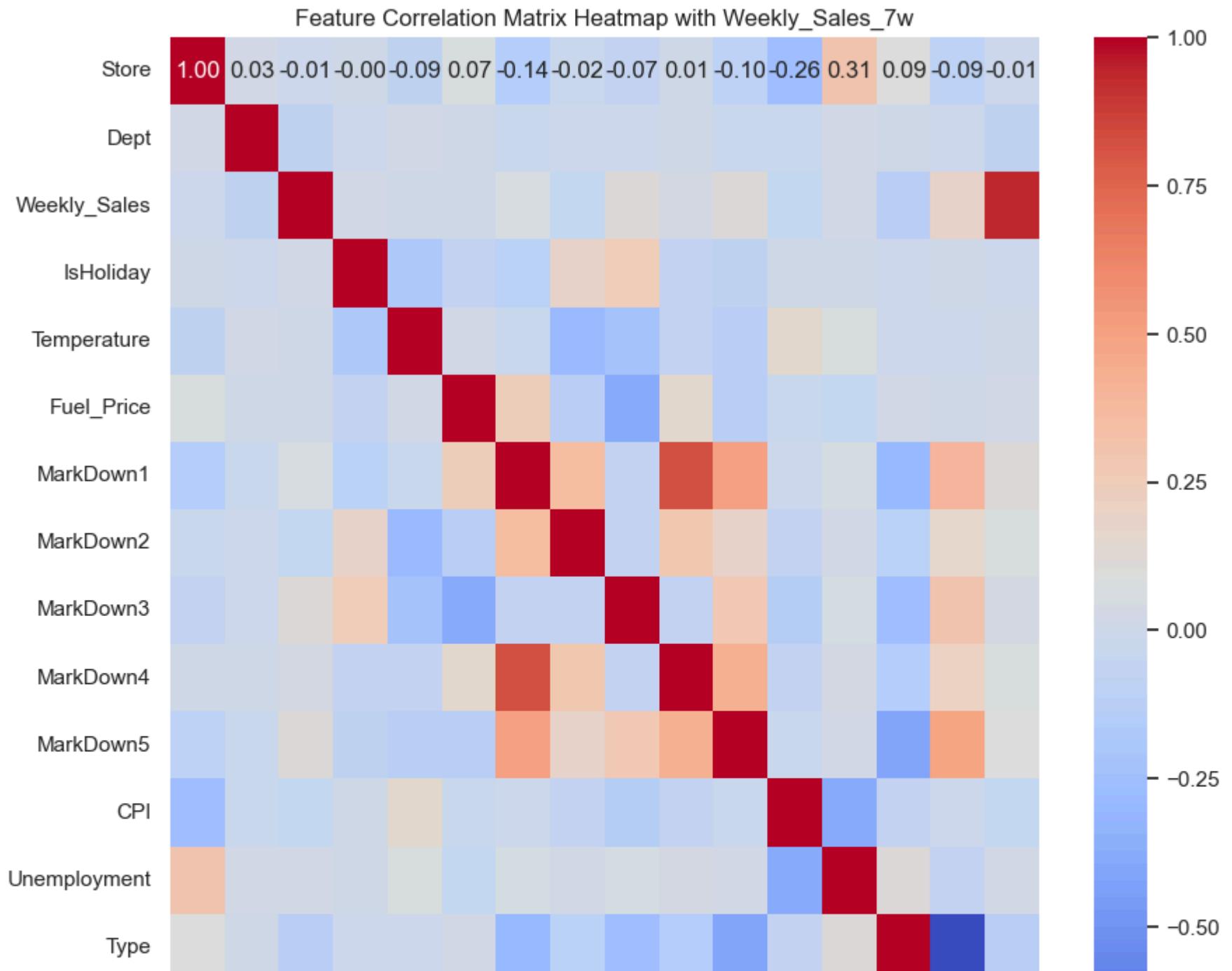
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.071141	-0.144947	-0.023186	-0.066454	0.010946	
Dept	0.006045	-0.017007	-0.006732	-0.011691	0.002762	
Weekly_Sales	0.011365	0.062277	-0.049638	0.117479	0.040731	
IsHoliday	-0.075937	-0.113993	0.175969	0.256435	-0.075263	
Temperature	0.032407	-0.029543	-0.292609	-0.242815	-0.063016	
Fuel_Price	1.000000	0.242631	-0.121091	-0.387026	0.151717	
MarkDown1	0.242631	1.000000	0.358212	-0.059375	0.820835	
MarkDown2	-0.121091	0.358212	1.000000	-0.053003	0.291659	
MarkDown3	-0.387026	-0.059375	-0.053003	1.000000	-0.079032	
MarkDown4	0.151717	0.820835	0.291659	-0.079032	1.000000	
MarkDown5	-0.125015	0.499343	0.188728	0.267329	0.438826	
CPI	-0.031782	-0.002465	-0.053293	-0.141903	-0.058580	
Unemployment	-0.048474	0.046635	0.018659	0.042175	0.033806	
Type	0.033058	-0.299083	-0.108953	-0.262605	-0.144731	
Size	0.011213	0.401749	0.162493	0.301867	0.215708	
Weekly_Sales_7w	0.019034	0.109933	0.071115	0.035723	0.070830	

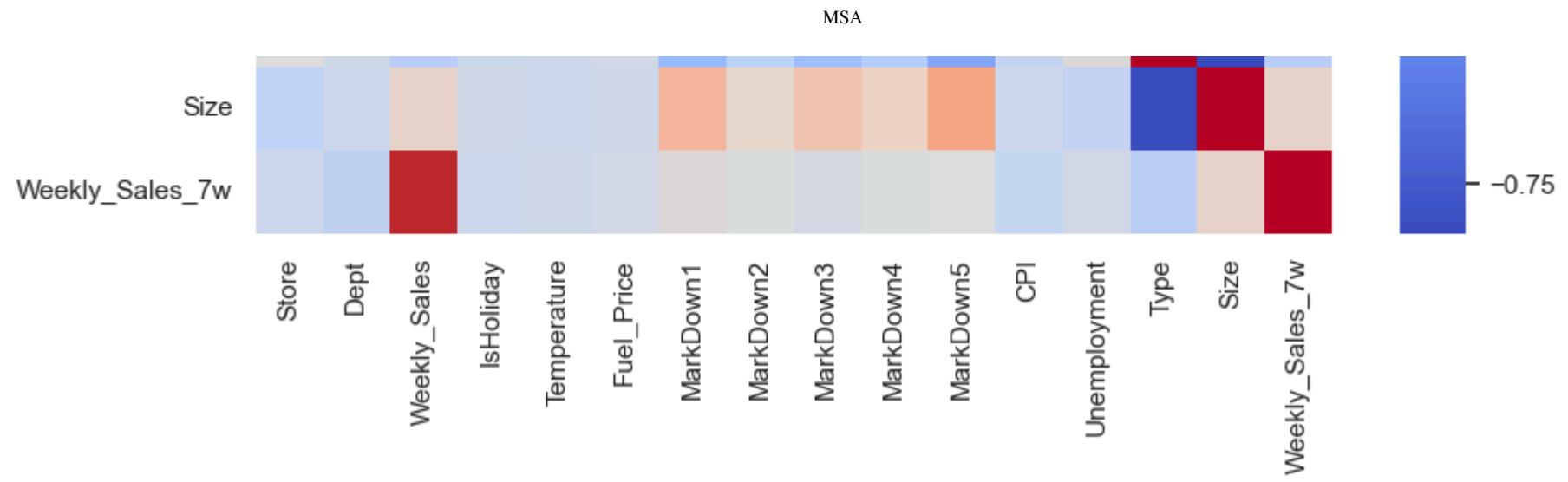
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.100120	-0.257621	0.310773	0.089133	-0.087349	
Dept	-0.018963	-0.021556	0.014710	0.000229	-0.011130	
Weekly_Sales	0.107066	-0.047909	0.018847	-0.132492	0.171606	

IsHoliday	-0.083920	0.003539	0.001775	-0.001762	0.001644
Temperature	-0.124226	0.153822	0.082816	-0.001969	-0.008664
Fuel_Price	-0.125015	-0.031782	-0.048474	0.033058	0.011213
MarkDown1	0.499343	-0.002465	0.046635	-0.299083	0.401749
MarkDown2	0.188728	-0.053293	0.018659	-0.108953	0.162493
MarkDown3	0.267329	-0.141903	0.042175	-0.262605	0.301867
MarkDown4	0.438826	-0.058580	0.033806	-0.144731	0.215708
MarkDown5	1.000000	-0.030229	0.019736	-0.395453	0.495386
CPI	-0.030229	1.000000	-0.387111	-0.075816	-0.015907
Unemployment	0.019736	-0.387111	1.000000	0.109799	-0.057990
Type	-0.395453	-0.075816	0.109799	1.000000	-0.818801
Size	0.495386	-0.015907	-0.057990	-0.818801	1.000000
Weekly_Sales_7w	0.092011	-0.046832	0.015058	-0.132498	0.171659

Weekly_Sales_7w

Store	-0.008953
Dept	-0.080418
Weekly_Sales	0.931109
IsHoliday	-0.011865
Temperature	0.009968
Fuel_Price	0.019034
MarkDown1	0.109933
MarkDown2	0.071115
MarkDown3	0.035723
MarkDown4	0.070830
MarkDown5	0.092011
CPI	-0.046832
Unemployment	0.015058
Type	-0.132498
Size	0.171659
Weekly_Sales_7w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025451	-0.009841	-0.000096	-0.086293	
Dept	0.025451	1.000000	-0.085263	-0.001849	0.013225	
Weekly_Sales	-0.009841	-0.085263	1.000000	0.012206	0.007005	
IsHoliday	-0.000096	-0.001849	0.012206	1.000000	-0.164077	
Temperature	-0.086293	0.013225	0.007005	-0.164077	1.000000	
Fuel_Price	0.071086	0.006003	0.011426	-0.075086	0.032665	
MarkDown1	-0.144058	-0.018841	0.070168	-0.114953	-0.028550	
MarkDown2	-0.022382	-0.008940	-0.037874	0.172198	-0.290115	
MarkDown3	-0.066018	-0.014102	0.125853	0.253697	-0.242146	
MarkDown4	0.010477	0.002258	0.046289	-0.075739	-0.063761	
MarkDown5	-0.101073	-0.021575	0.110532	-0.084623	-0.122944	
CPI	-0.257620	-0.021550	-0.047753	0.003781	0.153943	
Unemployment	0.310744	0.014708	0.018893	0.001989	0.082916	
Type	0.089242	0.000299	-0.132878	-0.000608	-0.002100	
Size	-0.087438	-0.011211	0.172112	0.000586	-0.008777	
Weekly_Sales_8w	-0.008878	-0.080256	0.928523	-0.008996	0.008635	

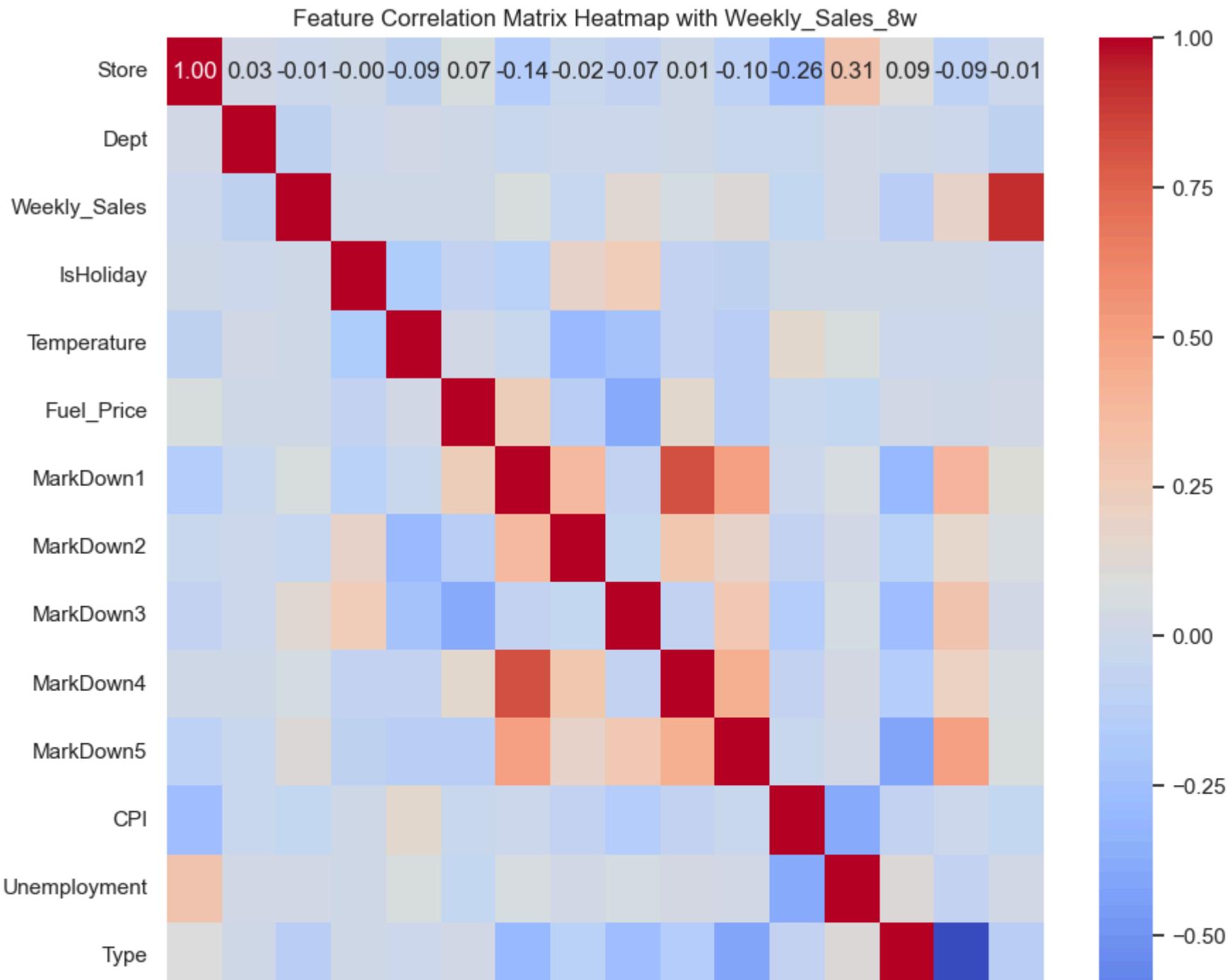
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.071086	-0.144058	-0.022382	-0.066018	0.010477	
Dept	0.006003	-0.018841	-0.008940	-0.014102	0.002258	
Weekly_Sales	0.011426	0.070168	-0.037874	0.125853	0.046289	
IsHoliday	-0.075086	-0.114953	0.172198	0.253697	-0.075739	
Temperature	0.032665	-0.028550	-0.290115	-0.242146	-0.063761	
Fuel_Price	1.000000	0.240586	-0.122275	-0.386649	0.148726	
MarkDown1	0.240586	1.000000	0.360753	-0.055467	0.821168	
MarkDown2	-0.122275	0.360753	1.000000	-0.047312	0.293659	
MarkDown3	-0.386649	-0.055467	-0.047312	1.000000	-0.074031	
MarkDown4	0.148726	0.821168	0.293659	-0.074031	1.000000	
MarkDown5	-0.126380	0.500238	0.191310	0.268774	0.440438	
CPI	-0.031921	-0.004626	-0.055697	-0.144044	-0.060691	
Unemployment	-0.048378	0.048204	0.019041	0.042923	0.034234	
Type	0.032987	-0.299403	-0.110236	-0.261928	-0.144402	
Size	0.011314	0.402533	0.164432	0.301635	0.215987	
Weekly_Sales_8w	0.019142	0.099491	0.056948	0.031753	0.061777	

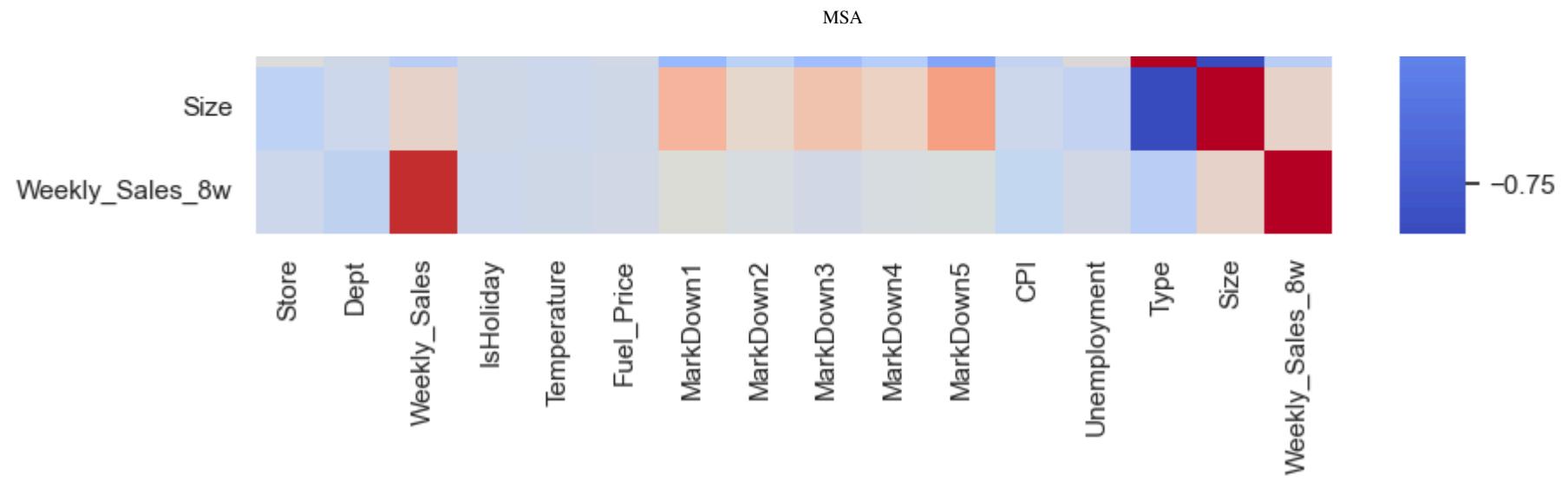
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.101073	-0.257620	0.310744	0.089242	-0.087438	
Dept	-0.021575	-0.021550	0.014708	0.000299	-0.011211	
Weekly_Sales	0.110532	-0.047753	0.018893	-0.132878	0.172112	

IsHoliday	-0.084623	0.003781	0.001989	-0.000608	0.000586
Temperature	-0.122944	0.153943	0.082916	-0.002100	-0.008777
Fuel_Price	-0.126380	-0.031921	-0.048378	0.032987	0.011314
MarkDown1	0.500238	-0.004626	0.048204	-0.299403	0.402533
MarkDown2	0.191310	-0.055697	0.019041	-0.110236	0.164432
MarkDown3	0.268774	-0.144044	0.042923	-0.261928	0.301635
MarkDown4	0.440438	-0.060691	0.034234	-0.144402	0.215987
MarkDown5	1.000000	-0.029328	0.018497	-0.396401	0.496606
CPI	-0.029328	1.000000	-0.387205	-0.075882	-0.015899
Unemployment	0.018497	-0.387205	1.000000	0.109899	-0.058049
Type	-0.396401	-0.075882	0.109899	1.000000	-0.818772
Size	0.496606	-0.015899	-0.058049	-0.818772	1.000000
Weekly_Sales_8w	0.083449	-0.046833	0.014987	-0.132540	0.171755

Weekly_Sales_8w

Store	-0.008878
Dept	-0.080256
Weekly_Sales	0.928523
IsHoliday	-0.008996
Temperature	0.008635
Fuel_Price	0.019142
MarkDown1	0.099491
MarkDown2	0.056948
MarkDown3	0.031753
MarkDown4	0.061777
MarkDown5	0.083449
CPI	-0.046833
Unemployment	0.014987
Type	-0.132540
Size	0.171755
Weekly_Sales_8w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025524	-0.010016	-0.000680	-0.086086	
Dept	0.025524	1.000000	-0.086059	-0.002602	0.013944	
Weekly_Sales	-0.010016	-0.086059	1.000000	0.011058	0.004640	
IsHoliday	-0.000680	-0.002602	0.011058	1.000000	-0.164656	
Temperature	-0.086086	0.013944	0.004640	-0.164656	1.000000	
Fuel_Price	0.070858	0.005876	0.011427	-0.076615	0.032635	
MarkDown1	-0.144516	-0.021131	0.070214	-0.118499	-0.029269	
MarkDown2	-0.023352	-0.013440	-0.030510	0.171507	-0.289489	
MarkDown3	-0.066000	-0.014859	0.122827	0.255022	-0.241597	
MarkDown4	0.010741	-0.000358	0.044944	-0.080869	-0.063349	
MarkDown5	-0.100316	-0.021926	0.108757	-0.089100	-0.121931	
CPI	-0.257663	-0.021471	-0.047644	0.004201	0.153694	
Unemployment	0.310659	0.014777	0.019137	0.001916	0.082943	
Type	0.089346	0.000457	-0.133054	-0.001171	-0.001675	
Size	-0.087507	-0.011394	0.172436	0.001106	-0.009428	
Weekly_Sales_9w	-0.008970	-0.080046	0.924844	-0.010869	0.008878	

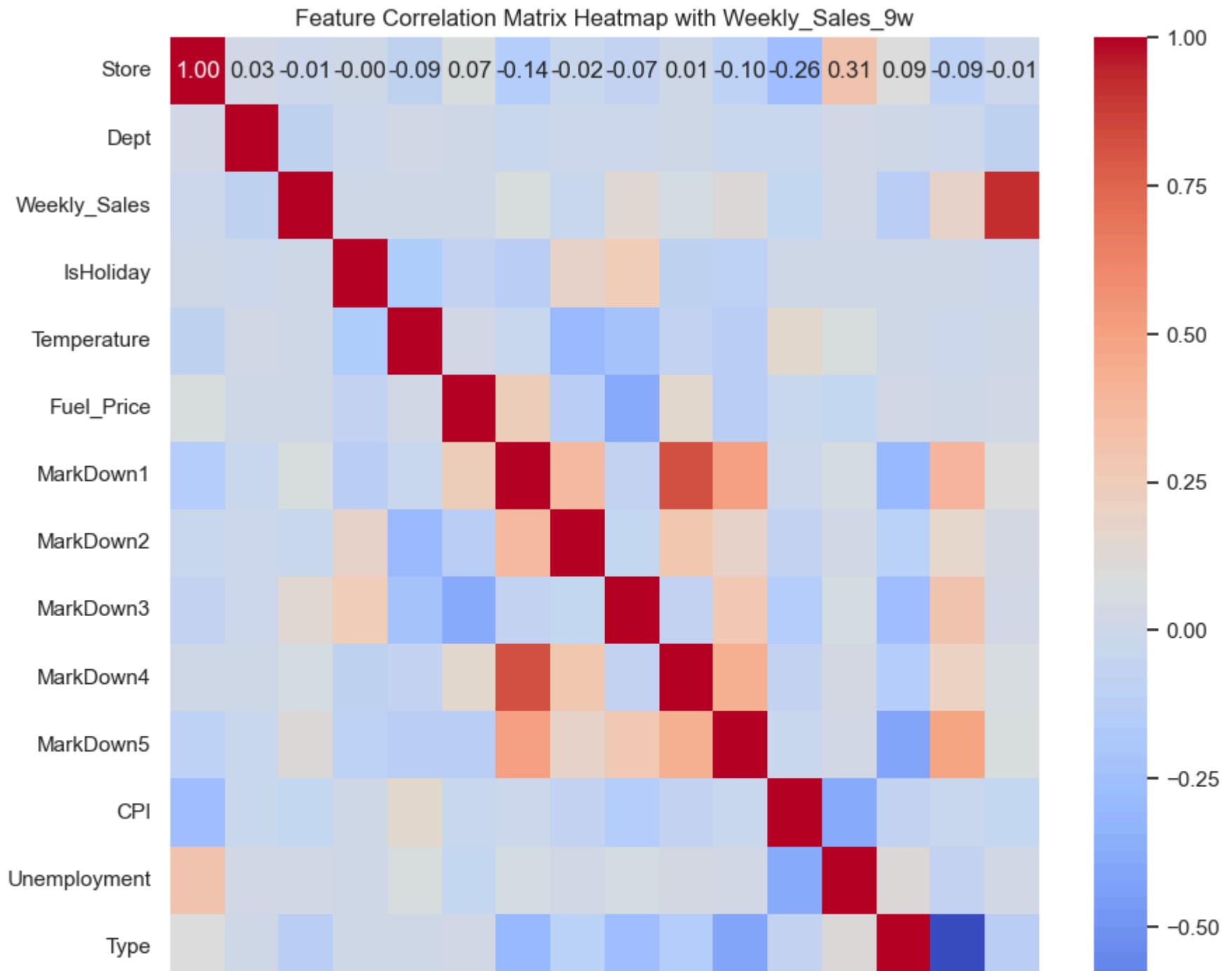
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.070858	-0.144516	-0.023352	-0.066000	0.010741	
Dept	0.005876	-0.021131	-0.013440	-0.014859	-0.000358	
Weekly_Sales	0.011427	0.070214	-0.030510	0.122827	0.044944	
IsHoliday	-0.076615	-0.118499	0.171507	0.255022	-0.080869	
Temperature	0.032635	-0.029269	-0.289489	-0.241597	-0.063349	
Fuel_Price	1.000000	0.240098	-0.121689	-0.385475	0.149139	
MarkDown1	0.240098	1.000000	0.361489	-0.054571	0.821460	
MarkDown2	-0.121689	0.361489	1.000000	-0.045664	0.293395	
MarkDown3	-0.385475	-0.054571	-0.045664	1.000000	-0.073947	
MarkDown4	0.149139	0.821460	0.293395	-0.073947	1.000000	
MarkDown5	-0.125211	0.500906	0.192659	0.268037	0.439649	
CPI	-0.032054	-0.006007	-0.055841	-0.144212	-0.061075	
Unemployment	-0.048325	0.047391	0.019274	0.043128	0.033955	
Type	0.033053	-0.299281	-0.112674	-0.261536	-0.143975	
Size	0.011293	0.402213	0.167514	0.301972	0.215332	
Weekly_Sales_9w	0.019295	0.090710	0.037598	0.029801	0.058157	

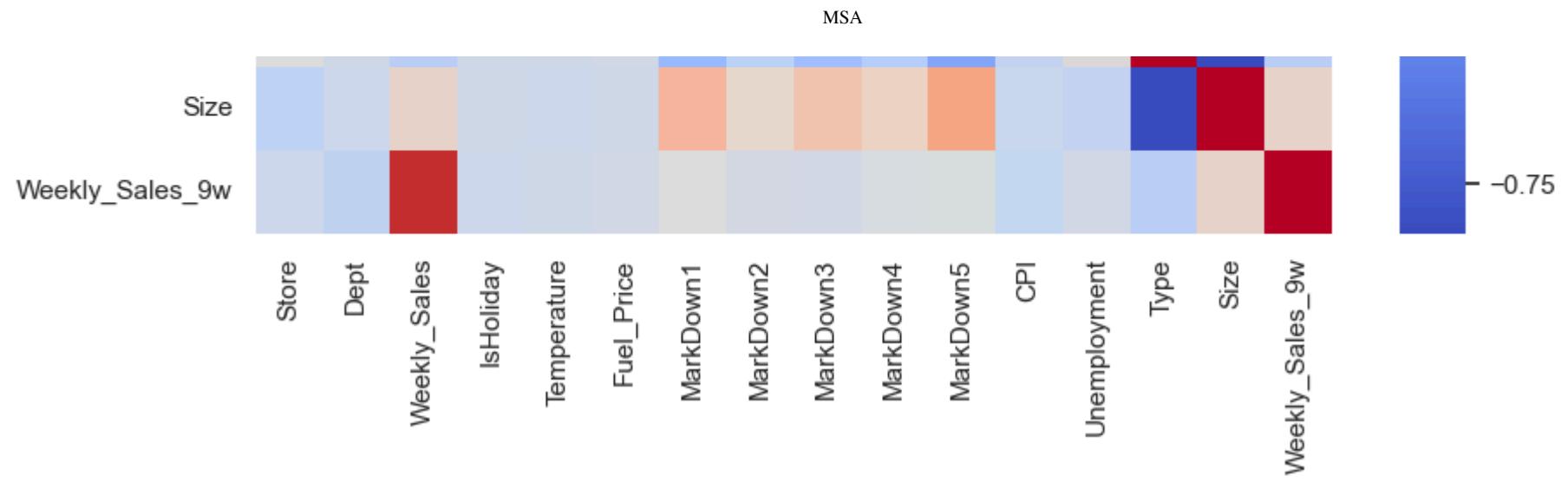
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.100316	-0.257663	0.310659	0.089346	-0.087507	
Dept	-0.021926	-0.021471	0.014777	0.000457	-0.011394	
Weekly_Sales	0.108757	-0.047644	0.019137	-0.133054	0.172436	

IsHoliday	-0.089100	0.004201	0.001916	-0.001171	0.001106
Temperature	-0.121931	0.153694	0.082943	-0.001675	-0.009428
Fuel_Price	-0.125211	-0.032054	-0.048325	0.033053	0.011293
MarkDown1	0.500906	-0.006007	0.047391	-0.299281	0.402213
MarkDown2	0.192659	-0.055841	0.019274	-0.112674	0.167514
MarkDown3	0.268037	-0.144212	0.043128	-0.261536	0.301972
MarkDown4	0.439649	-0.061075	0.033955	-0.143975	0.215332
MarkDown5	1.000000	-0.030734	0.018774	-0.395400	0.495338
CPI	-0.030734	1.000000	-0.387311	-0.075871	-0.015962
Unemployment	0.018774	-0.387311	1.000000	0.109881	-0.058016
Type	-0.395400	-0.075871	0.109881	1.000000	-0.818710
Size	0.495338	-0.015962	-0.058016	-0.818710	1.000000
Weekly_Sales_9w	0.083411	-0.046688	0.015038	-0.132650	0.171808

Weekly_Sales_9w

Store	-0.008970
Dept	-0.080046
Weekly_Sales	0.924844
IsHoliday	-0.010869
Temperature	0.008878
Fuel_Price	0.019295
MarkDown1	0.090710
MarkDown2	0.037598
MarkDown3	0.029801
MarkDown4	0.058157
MarkDown5	0.083411
CPI	-0.046688
Unemployment	0.015038
Type	-0.132650
Size	0.171808
Weekly_Sales_9w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025356	-0.010251	-0.000611	-0.085806	
Dept	0.025356	1.000000	-0.086471	-0.002499	0.013981	
Weekly_Sales	-0.010251	-0.086471	1.000000	0.012623	0.003094	
IsHoliday	-0.000611	-0.002499	0.012623	1.000000	-0.164844	
Temperature	-0.085806	0.013981	0.003094	-0.164844	1.000000	
Fuel_Price	0.070761	0.005705	0.011796	-0.075211	0.032571	
MarkDown1	-0.145428	-0.021335	0.067369	-0.114981	-0.028618	
MarkDown2	-0.023893	-0.013672	-0.028085	0.171073	-0.289169	
MarkDown3	-0.065179	-0.015326	0.120477	0.256561	-0.241949	
MarkDown4	0.009886	-0.001347	0.039546	-0.076177	-0.062606	
MarkDown5	-0.101318	-0.021914	0.106112	-0.085516	-0.122241	
CPI	-0.257618	-0.021463	-0.047583	0.004282	0.153847	
Unemployment	0.310690	0.014637	0.018940	0.001051	0.082970	
Type	0.089400	0.000409	-0.133372	-0.002057	-0.001509	
Size	-0.087569	-0.011411	0.172866	0.002445	-0.009719	
Weekly_Sales_10w	-0.009109	-0.079962	0.920150	-0.014005	0.007175	

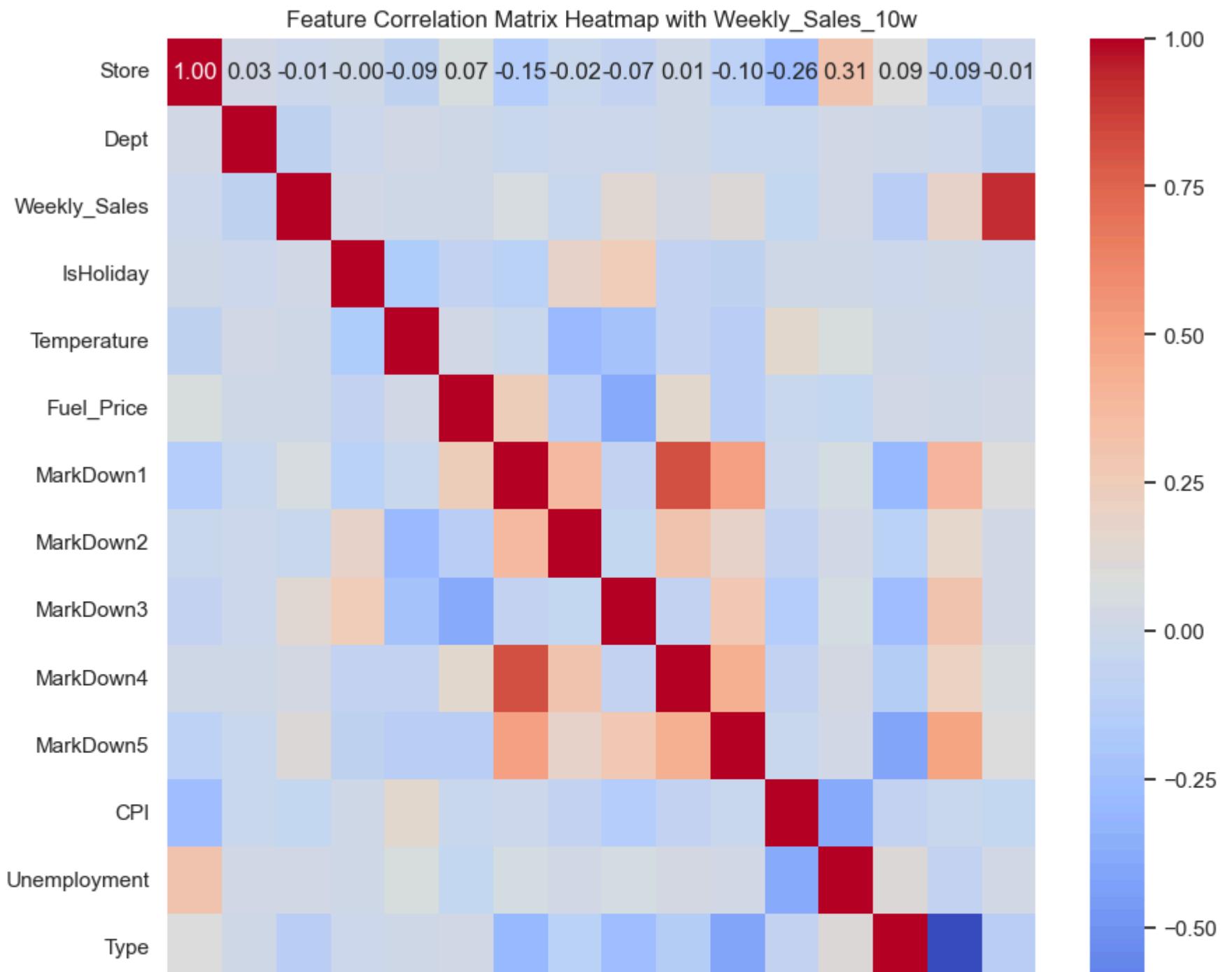
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.070761	-0.145428	-0.023893	-0.065179	0.009886	
Dept	0.005705	-0.021335	-0.013672	-0.015326	-0.001347	
Weekly_Sales	0.011796	0.067369	-0.028085	0.120477	0.039546	
IsHoliday	-0.075211	-0.114981	0.171073	0.256561	-0.076177	
Temperature	0.032571	-0.028618	-0.289169	-0.241949	-0.062606	
Fuel_Price	1.000000	0.240978	-0.120422	-0.385193	0.150276	
MarkDown1	0.240978	1.000000	0.364305	-0.057018	0.821110	
MarkDown2	-0.120422	0.364305	1.000000	-0.047178	0.296785	
MarkDown3	-0.385193	-0.057018	-0.047178	1.000000	-0.077484	
MarkDown4	0.150276	0.821110	0.296785	-0.077484	1.000000	
MarkDown5	-0.123845	0.501819	0.195428	0.265607	0.439420	
CPI	-0.032126	-0.005654	-0.056781	-0.144076	-0.060346	
Unemployment	-0.048321	0.047355	0.018817	0.042986	0.034352	
Type	0.032833	-0.299250	-0.113696	-0.261069	-0.143735	
Size	0.011483	0.401781	0.168156	0.301193	0.213935	
Weekly_Sales_10w	0.019445	0.095791	0.032930	0.032973	0.066608	

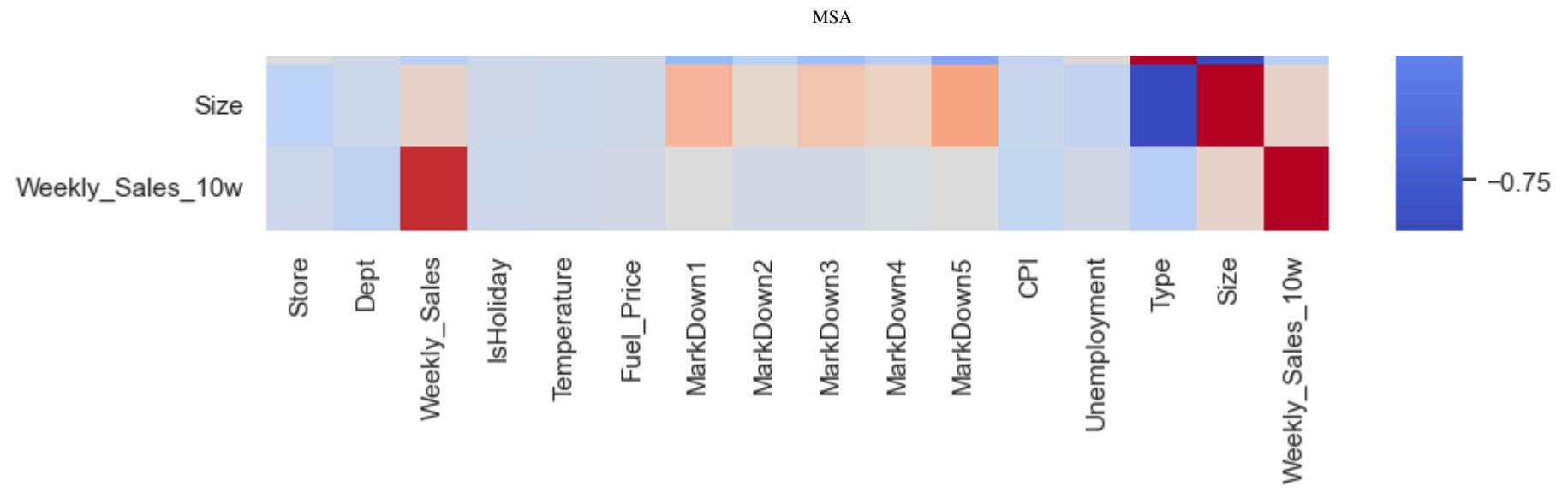
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.101318	-0.257618	0.310690	0.089400	-0.087569	
Dept	-0.021914	-0.021463	0.014637	0.000409	-0.011411	
Weekly_Sales	0.106112	-0.047583	0.018940	-0.133372	0.172866	

IsHoliday	-0.085516	0.004282	0.001051	-0.002057	0.002445
Temperature	-0.122241	0.153847	0.082970	-0.001509	-0.009719
Fuel_Price	-0.123845	-0.032126	-0.048321	0.032833	0.011483
MarkDown1	0.501819	-0.005654	0.047355	-0.299250	0.401781
MarkDown2	0.195428	-0.056781	0.018817	-0.113696	0.168156
MarkDown3	0.265607	-0.144076	0.042986	-0.261069	0.301193
MarkDown4	0.439420	-0.060346	0.034352	-0.143735	0.213935
MarkDown5	1.000000	-0.029992	0.018867	-0.395092	0.495162
CPI	-0.029992	1.000000	-0.387300	-0.075926	-0.015967
Unemployment	0.018867	-0.387300	1.000000	0.109972	-0.058026
Type	-0.395092	-0.075926	0.109972	1.000000	-0.818679
Size	0.495162	-0.015967	-0.058026	-0.818679	1.000000
Weekly_Sales_10w	0.091571	-0.046607	0.014522	-0.132773	0.171847

Weekly_Sales_10w

Store	-0.009109
Dept	-0.079962
Weekly_Sales	0.920150
IsHoliday	-0.014005
Temperature	0.007175
Fuel_Price	0.019445
MarkDown1	0.095791
MarkDown2	0.032930
MarkDown3	0.032973
MarkDown4	0.066608
MarkDown5	0.091571
CPI	-0.046607
Unemployment	0.014522
Type	-0.132773
Size	0.171847
Weekly_Sales_10w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025356	-0.010315	-0.000600	-0.085665	
Dept	0.025356	1.000000	-0.086956	-0.001715	0.014043	
Weekly_Sales	-0.010315	-0.086956	1.000000	0.009760	0.001537	
IsHoliday	-0.000600	-0.001715	0.009760	1.000000	-0.163901	
Temperature	-0.085665	0.014043	0.001537	-0.163901	1.000000	
Fuel_Price	0.070657	0.005359	0.012582	-0.075439	0.032598	
MarkDown1	-0.146589	-0.022132	0.078333	-0.115635	-0.026907	
MarkDown2	-0.024264	-0.012543	-0.023329	0.172608	-0.289040	
MarkDown3	-0.065493	-0.015464	0.119285	0.254966	-0.241234	
MarkDown4	0.009331	-0.000704	0.050984	-0.076370	-0.060226	
MarkDown5	-0.102372	-0.021555	0.111906	-0.085698	-0.121193	
CPI	-0.257525	-0.021571	-0.047230	0.003811	0.153858	
Unemployment	0.310639	0.014732	0.018546	0.001663	0.083106	
Type	0.089573	0.000567	-0.133758	-0.000892	-0.001207	
Size	-0.087760	-0.011542	0.173219	0.001060	-0.010160	
Weekly_Sales_11w	-0.009314	-0.080058	0.915887	-0.008694	0.005868	

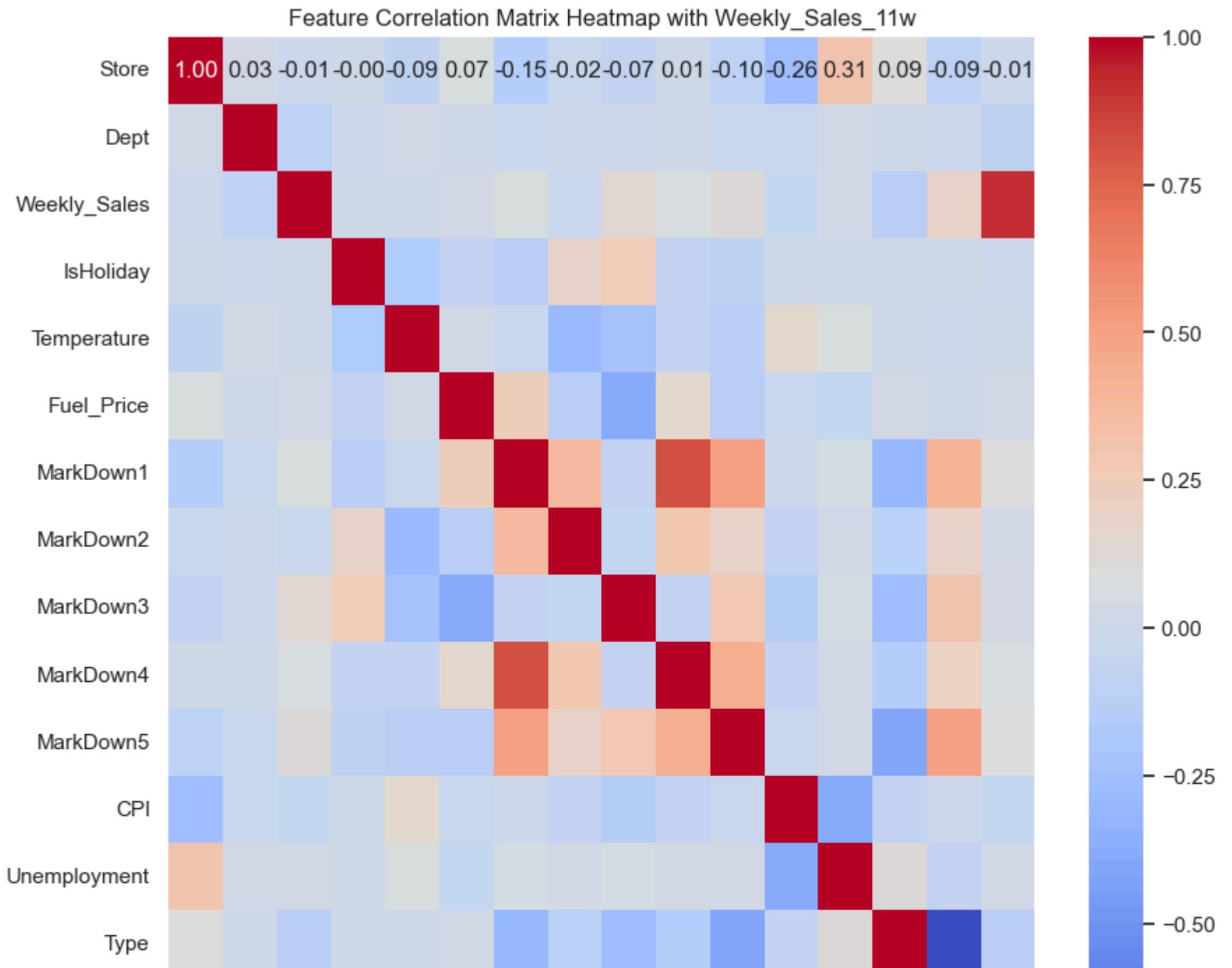
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.070657	-0.146589	-0.024264	-0.065493	0.009331	
Dept	0.005359	-0.022132	-0.012543	-0.015464	-0.000704	
Weekly_Sales	0.012582	0.078333	-0.023329	0.119285	0.050984	
IsHoliday	-0.075439	-0.115635	0.172608	0.254966	-0.076370	
Temperature	0.032598	-0.026907	-0.289040	-0.241234	-0.060226	
Fuel_Price	1.000000	0.242202	-0.120919	-0.384123	0.152396	
MarkDown1	0.242202	1.000000	0.363116	-0.054158	0.821586	
MarkDown2	-0.120919	0.363116	1.000000	-0.046935	0.295045	
MarkDown3	-0.384123	-0.054158	-0.046935	1.000000	-0.075110	
MarkDown4	0.152396	0.821586	0.295045	-0.075110	1.000000	
MarkDown5	-0.123855	0.500667	0.193890	0.268448	0.437992	
CPI	-0.032107	-0.004171	-0.056177	-0.143068	-0.059092	
Unemployment	-0.048298	0.046023	0.019295	0.042225	0.033629	
Type	0.032839	-0.301981	-0.114501	-0.262294	-0.147373	
Size	0.011519	0.405419	0.169387	0.302350	0.218242	
Weekly_Sales_11w	0.018968	0.087846	0.030258	0.039232	0.057190	

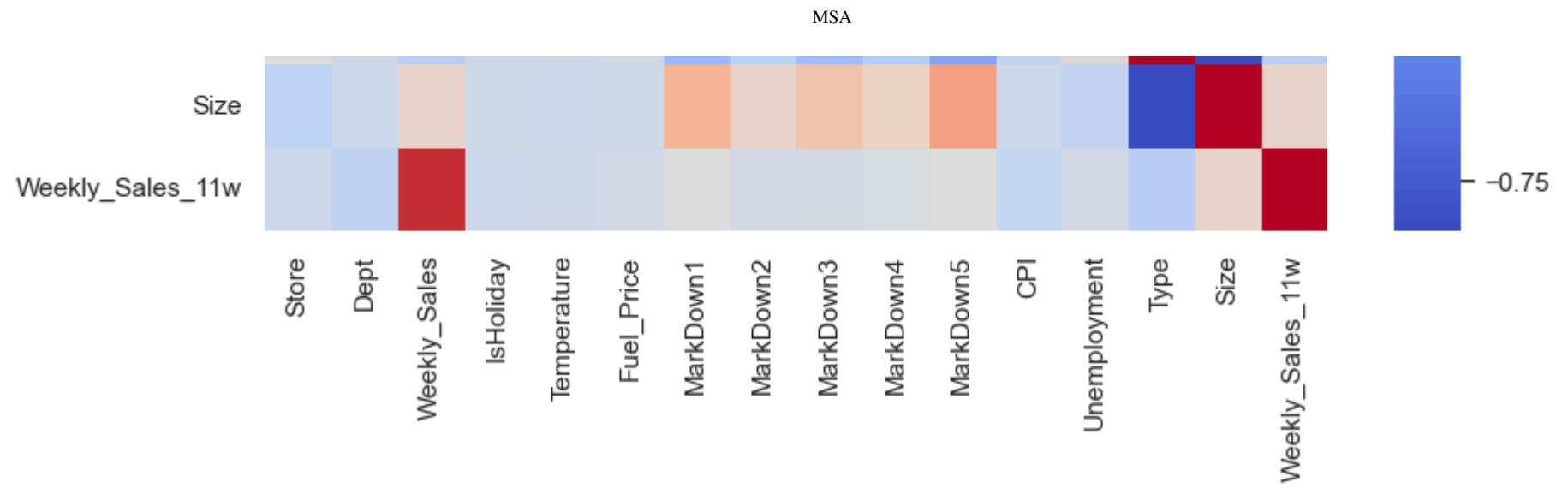
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.102372	-0.257525	0.310639	0.089573	-0.087760	
Dept	-0.021555	-0.021571	0.014732	0.000567	-0.011542	
Weekly_Sales	0.111906	-0.047230	0.018546	-0.133758	0.173219	

IsHoliday	-0.085698	0.003811	0.001663	-0.000892	0.001060
Temperature	-0.121193	0.153858	0.083106	-0.001207	-0.010160
Fuel_Price	-0.123855	-0.032107	-0.048298	0.032839	0.011519
MarkDown1	0.500667	-0.004171	0.046023	-0.301981	0.405419
MarkDown2	0.193890	-0.056177	0.019295	-0.114501	0.169387
MarkDown3	0.268448	-0.143068	0.042225	-0.262294	0.302350
MarkDown4	0.437992	-0.059092	0.033629	-0.147373	0.218242
MarkDown5	1.000000	-0.029379	0.017983	-0.396610	0.496757
CPI	-0.029379	1.000000	-0.387280	-0.076100	-0.015882
Unemployment	0.017983	-0.387280	1.000000	0.110126	-0.058188
Type	-0.396610	-0.076100	0.110126	1.000000	-0.818652
Size	0.496757	-0.015882	-0.058188	-0.818652	1.000000
Weekly_Sales_11w	0.093445	-0.046173	0.014009	-0.132895	0.171770

Weekly_Sales_11w

Store	-0.009314
Dept	-0.080058
Weekly_Sales	0.915887
IsHoliday	-0.008694
Temperature	0.005868
Fuel_Price	0.018968
MarkDown1	0.087846
MarkDown2	0.030258
MarkDown3	0.039232
MarkDown4	0.057190
MarkDown5	0.093445
CPI	-0.046173
Unemployment	0.014009
Type	-0.132895
Size	0.171770
Weekly_Sales_11w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025229	-0.010315	0.001032	-0.085646	
Dept	0.025229	1.000000	-0.087537	0.001082	0.013979	
Weekly_Sales	-0.010315	-0.087537	1.000000	0.006701	0.000880	
IsHoliday	0.001032	0.001082	0.006701	1.000000	-0.168291	
Temperature	-0.085646	0.013979	0.000880	-0.168291	1.000000	
Fuel_Price	0.070615	0.005068	0.013133	-0.074733	0.032966	
MarkDown1	-0.147672	-0.020893	0.082411	-0.115501	-0.026170	
MarkDown2	-0.023716	-0.010203	-0.022243	0.173925	-0.288500	
MarkDown3	-0.065947	-0.014440	0.120213	0.253623	-0.242194	
MarkDown4	0.008292	0.000952	0.053512	-0.075914	-0.059377	
MarkDown5	-0.102535	-0.020099	0.113604	-0.086301	-0.122552	
CPI	-0.257643	-0.021686	-0.047014	0.003333	0.154022	
Unemployment	0.310749	0.014778	0.018217	0.002209	0.082882	
Type	0.089620	0.000673	-0.134332	0.001140	-0.001318	
Size	-0.087806	-0.011664	0.173928	-0.001569	-0.010208	
Weekly_Sales_12w	-0.009426	-0.080314	0.912891	0.003155	0.004383	

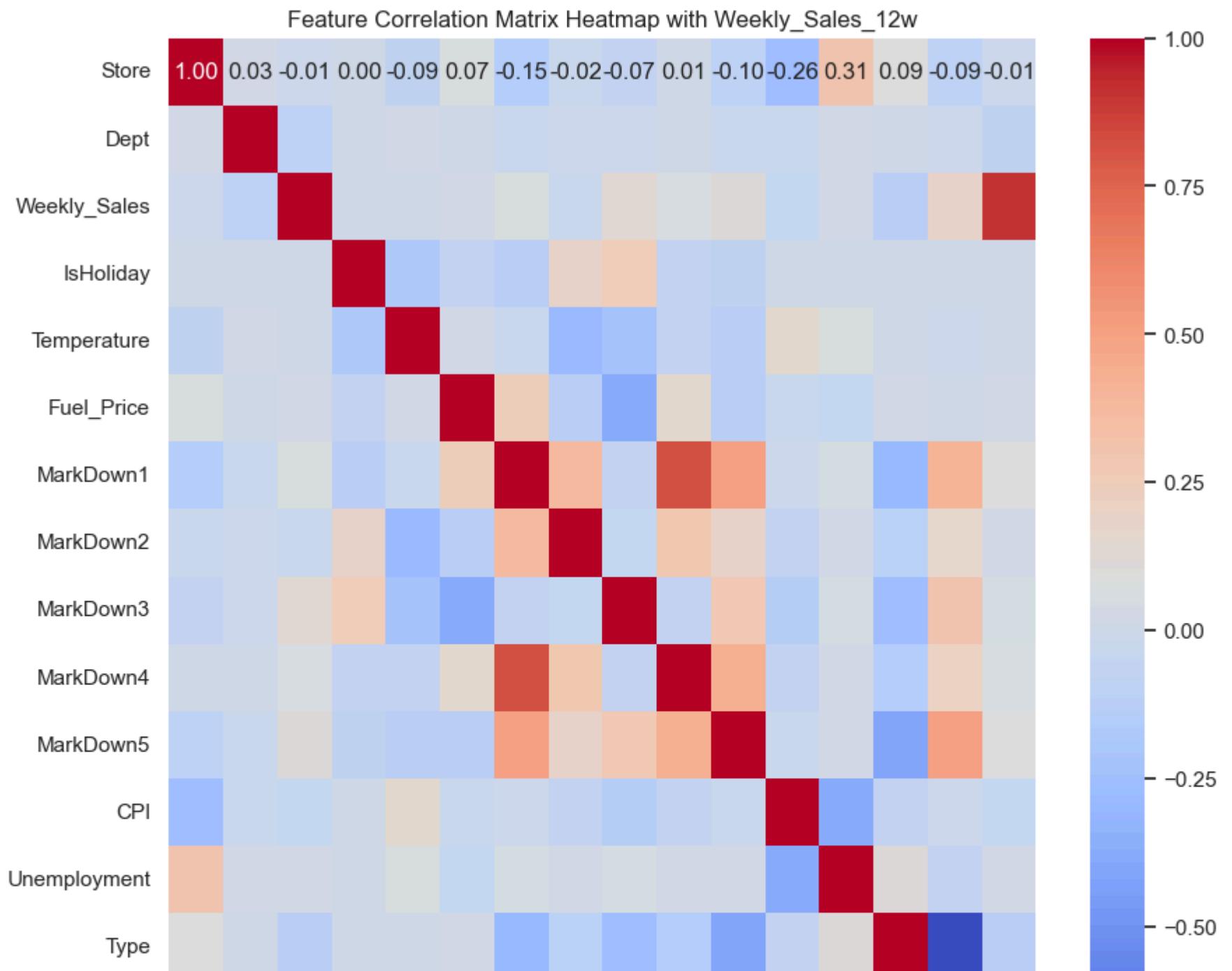
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.070615	-0.147672	-0.023716	-0.065947	0.008292	
Dept	0.005068	-0.020893	-0.010203	-0.014440	0.000952	
Weekly_Sales	0.013133	0.082411	-0.022243	0.120213	0.053512	
IsHoliday	-0.074733	-0.115501	0.173925	0.253623	-0.075914	
Temperature	0.032966	-0.026170	-0.288500	-0.242194	-0.059377	
Fuel_Price	1.000000	0.241726	-0.121563	-0.383547	0.151030	
MarkDown1	0.241726	1.000000	0.364111	-0.053071	0.821973	
MarkDown2	-0.121563	0.364111	1.000000	-0.046703	0.296169	
MarkDown3	-0.383547	-0.053071	-0.046703	1.000000	-0.073968	
MarkDown4	0.151030	0.821973	0.296169	-0.073968	1.000000	
MarkDown5	-0.123662	0.502246	0.194995	0.268003	0.440326	
CPI	-0.032335	-0.004207	-0.056206	-0.142605	-0.059723	
Unemployment	-0.048255	0.046883	0.019648	0.042207	0.033559	
Type	0.032735	-0.302362	-0.113628	-0.262237	-0.145835	
Size	0.011644	0.405599	0.168466	0.302248	0.217541	
Weekly_Sales_12w	0.018137	0.086305	0.031719	0.044751	0.053671	

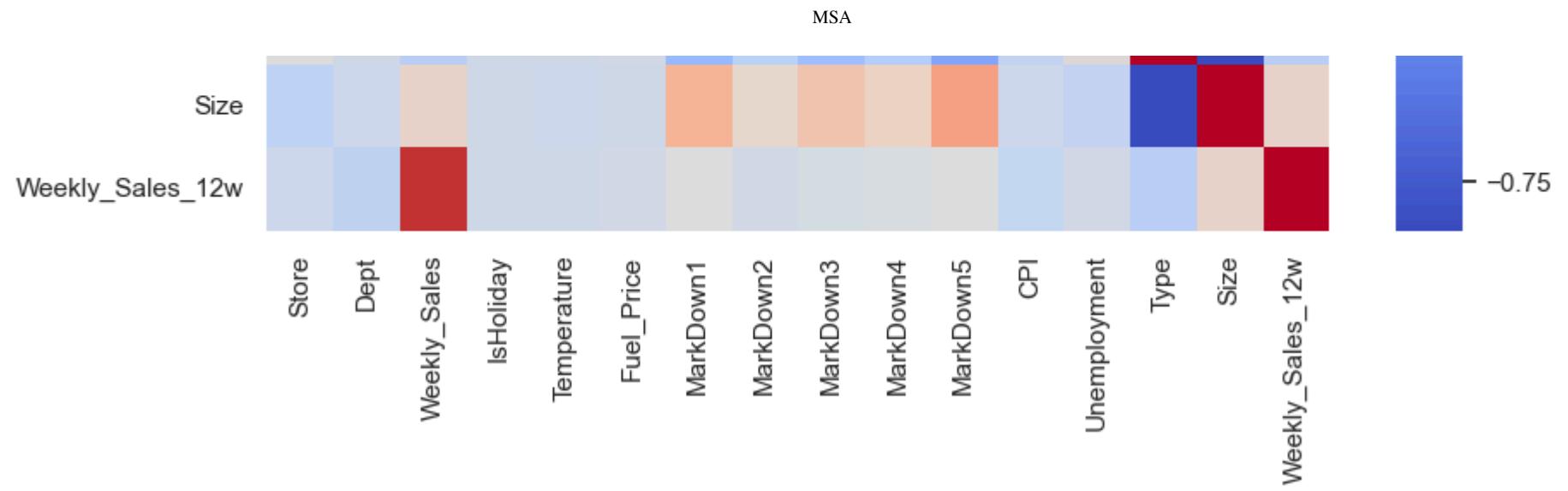
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.102535	-0.257643	0.310749	0.089620	-0.087806	
Dept	-0.020099	-0.021686	0.014778	0.000673	-0.011664	
Weekly_Sales	0.113604	-0.047014	0.018217	-0.134332	0.173928	

IsHoliday	-0.086301	0.003333	0.002209	0.001140	-0.001569
Temperature	-0.122552	0.154022	0.082882	-0.001318	-0.010208
Fuel_Price	-0.123662	-0.032335	-0.048255	0.032735	0.011644
MarkDown1	0.502246	-0.004207	0.046883	-0.302362	0.405599
MarkDown2	0.194995	-0.056206	0.019648	-0.113628	0.168466
MarkDown3	0.268003	-0.142605	0.042207	-0.262237	0.302248
MarkDown4	0.440326	-0.059723	0.033559	-0.145835	0.217541
MarkDown5	1.000000	-0.028674	0.018775	-0.397268	0.498306
CPI	-0.028674	1.000000	-0.387363	-0.076207	-0.015806
Unemployment	0.018775	-0.387363	1.000000	0.110171	-0.058284
Type	-0.397268	-0.076207	0.110171	1.000000	-0.818550
Size	0.498306	-0.015806	-0.058284	-0.818550	1.000000
Weekly_Sales_12w	0.092977	-0.045985	0.014011	-0.133171	0.172028

Weekly_Sales_12w

Store	-0.009426
Dept	-0.080314
Weekly_Sales	0.912891
IsHoliday	0.003155
Temperature	0.004383
Fuel_Price	0.018137
MarkDown1	0.086305
MarkDown2	0.031719
MarkDown3	0.044751
MarkDown4	0.053671
MarkDown5	0.092977
CPI	-0.045985
Unemployment	0.014011
Type	-0.133171
Size	0.172028
Weekly_Sales_12w	1.000000





Spearman Rank Correlation:

	Store	Dept	Weekly_Sales	IsHoliday	Temperature	\
Store	1.000000	0.025212	-0.010312	0.000471	-0.085553	
Dept	0.025212	1.000000	-0.088383	0.000134	0.014531	
Weekly_Sales	-0.010312	-0.088383	1.000000	0.007836	-0.000620	
IsHoliday	0.000471	0.000134	0.007836	1.000000	-0.165228	
Temperature	-0.085553	0.014531	-0.000620	-0.165228	1.000000	
Fuel_Price	0.070681	0.004985	0.013129	-0.075087	0.033338	
MarkDown1	-0.147549	-0.021392	0.078364	-0.115440	-0.027025	
MarkDown2	-0.024764	-0.010167	-0.025443	0.175376	-0.288501	
MarkDown3	-0.065494	-0.013474	0.119470	0.253183	-0.243266	
MarkDown4	0.008387	-0.000939	0.049060	-0.076505	-0.059618	
MarkDown5	-0.102489	-0.021416	0.111339	-0.086422	-0.122426	
CPI	-0.257731	-0.021636	-0.046945	0.003803	0.154054	
Unemployment	0.310832	0.014839	0.017843	0.001744	0.082779	
Type	0.089728	0.000832	-0.134754	0.000700	-0.001104	
Size	-0.087908	-0.011837	0.174507	-0.000642	-0.010587	
Weekly_Sales_13w	-0.009608	-0.080341	0.910169	0.002042	0.003656	

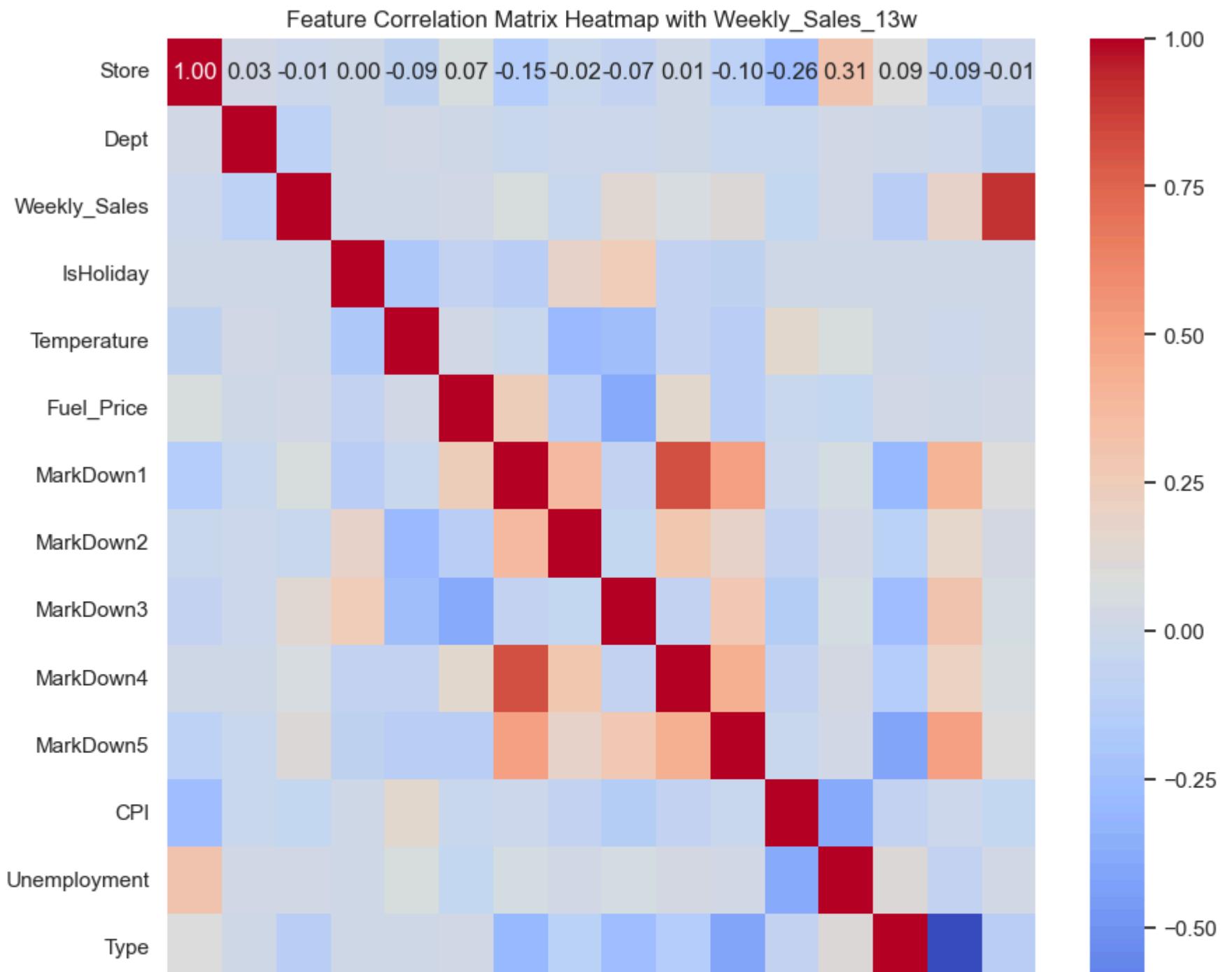
	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	\
Store	0.070681	-0.147549	-0.024764	-0.065494	0.008387	
Dept	0.004985	-0.021392	-0.010167	-0.013474	-0.000939	
Weekly_Sales	0.013129	0.078364	-0.025443	0.119470	0.049060	
IsHoliday	-0.075087	-0.115440	0.175376	0.253183	-0.076505	
Temperature	0.033338	-0.027025	-0.288501	-0.243266	-0.059618	
Fuel_Price	1.000000	0.241682	-0.121740	-0.384161	0.149688	
MarkDown1	0.241682	1.000000	0.363819	-0.052678	0.821387	
MarkDown2	-0.121740	0.363819	1.000000	-0.048158	0.295628	
MarkDown3	-0.384161	-0.052678	-0.048158	1.000000	-0.073509	
MarkDown4	0.149688	0.821387	0.295628	-0.073509	1.000000	
MarkDown5	-0.122482	0.502355	0.194094	0.268681	0.441513	
CPI	-0.032606	-0.004169	-0.055400	-0.142292	-0.059668	
Unemployment	-0.048273	0.047099	0.019704	0.042012	0.034494	
Type	0.032733	-0.302387	-0.112602	-0.261980	-0.145862	
Size	0.011642	0.405960	0.167621	0.301952	0.217220	
Weekly_Sales_13w	0.018369	0.088378	0.038584	0.046908	0.052652	

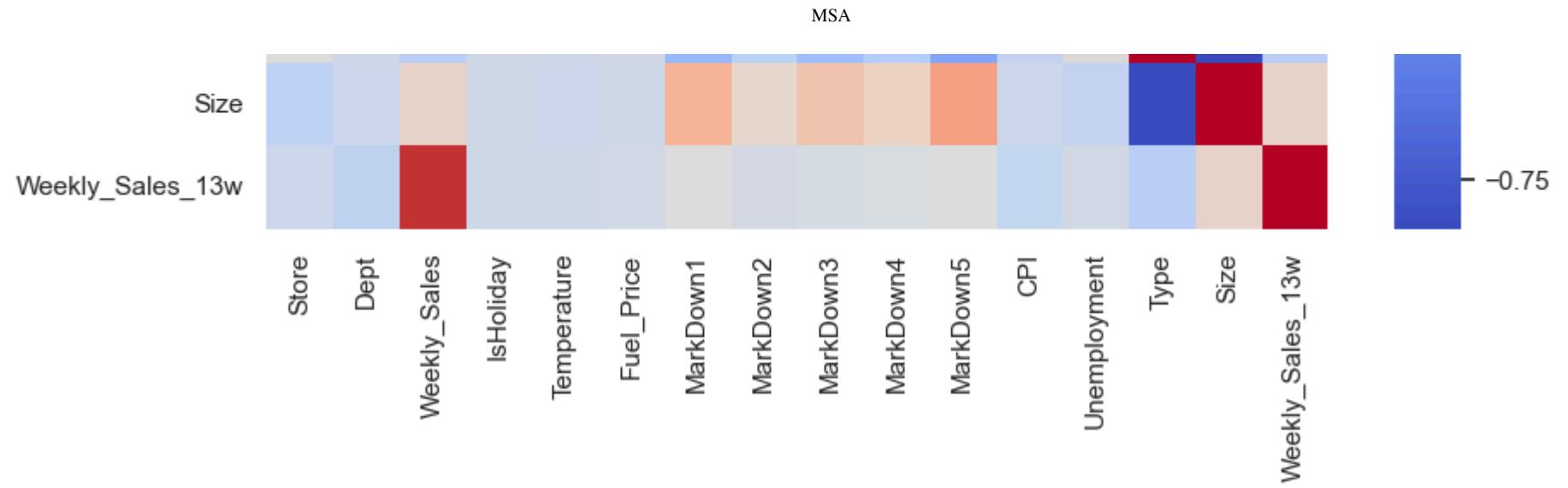
	MarkDown5	CPI	Unemployment	Type	Size	\
Store	-0.102489	-0.257731	0.310832	0.089728	-0.087908	
Dept	-0.021416	-0.021636	0.014839	0.000832	-0.011837	
Weekly_Sales	0.111339	-0.046945	0.017843	-0.134754	0.174507	

IsHoliday	-0.086422	0.003803	0.001744	0.000700	-0.000642
Temperature	-0.122426	0.154054	0.082779	-0.001104	-0.010587
Fuel_Price	-0.122482	-0.032606	-0.048273	0.032733	0.011642
MarkDown1	0.502355	-0.004169	0.047099	-0.302387	0.405960
MarkDown2	0.194094	-0.055400	0.019704	-0.112602	0.167621
MarkDown3	0.268681	-0.142292	0.042012	-0.261980	0.301952
MarkDown4	0.441513	-0.059668	0.034494	-0.145862	0.217220
MarkDown5	1.000000	-0.028503	0.018221	-0.397461	0.497455
CPI	-0.028503	1.000000	-0.387360	-0.076251	-0.015740
Unemployment	0.018221	-0.387360	1.000000	0.110161	-0.058351
Type	-0.397461	-0.076251	0.110161	1.000000	-0.818477
Size	0.497455	-0.015740	-0.058351	-0.818477	1.000000
Weekly_Sales_13w	0.092636	-0.045721	0.013860	-0.133453	0.172160

Weekly_Sales_13w

Store	-0.009608
Dept	-0.080341
Weekly_Sales	0.910169
IsHoliday	0.002042
Temperature	0.003656
Fuel_Price	0.018369
MarkDown1	0.088378
MarkDown2	0.038584
MarkDown3	0.046908
MarkDown4	0.052652
MarkDown5	0.092636
CPI	-0.045721
Unemployment	0.013860
Type	-0.133453
Size	0.172160
Weekly_Sales_13w	1.000000





6. Summary

Data Selection and Preparation: I selected the "w" store dataset, merging features, stores, and sales tables, with the goal of predicting sales for the next 12 weeks.

Data Analysis: The dataset contains 382,955 rows and 27 columns. Key findings include missing values in `MarkDown1-5` exceeding 70%, and "Store" and "Dept" being categorical despite being numeric. "Type" and "IsHoliday" need conversion to numeric formats. Significant variability was noted in several columns.

Data Cleaning: Data cleaning involved converting data types, handling missing values, and processing outliers. Separate datasets were stored for different target variables.

Visualization: Heatmaps, histograms, and box plots helped visualize missing values and data distribution, enhancing dataset understanding.

Correlation Analysis: Strong correlations were found between weekly sales and the target, as well as between other variables like CPI, unemployment, and Markdown values. This informed potential reductions in model inputs.

Conclusion: The initial data exploration and analysis provide a strong foundation for subsequent modeling.

MSA 2024 Phase 2 - Part 2 Training and Evaluation

In [38]:

```
!/opt/anaconda3/bin/python -m pip install joblib
!/opt/anaconda3/bin/python -m pip install Cython
!/opt/anaconda3/bin/python -m pip install pystan==2.19.1.1
!/opt/anaconda3/bin/python -m pip install prophet
from sklearn.linear_model import LinearRegression, Ridge, Lasso
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from xgboost import XGBRegressor
from keras.models import Sequential
from keras.layers import Input, LSTM, Dense
from statsmodels.tsa.arima.model import ARIMA
from prophet import Prophet
import tensorflow as tf
import sklearn.metrics as skm
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
```

```
Requirement already satisfied: joblib in /opt/anaconda3/lib/python3.11/site-packages (1.2.0)
Collecting Cython
  Using cached Cython-3.0.10-py2.py3-none-any.whl.metadata (3.2 kB)
Using cached Cython-3.0.10-py2.py3-none-any.whl (1.2 MB)
Installing collected packages: Cython
Successfully installed Cython-3.0.10
Collecting pystan==2.19.1.1
  Using cached pystan-2.19.1.1.tar.gz (16.2 MB)
  Preparing metadata (setup.py) ... done
Requirement already satisfied: Cython!=0.25.1,>=0.22 in /opt/anaconda3/lib/python3.11/site-packages (from pystan==2.19.1.1) (3.0.10)
Requirement already satisfied: numpy>=1.7 in /opt/anaconda3/lib/python3.11/site-packages (from pystan==2.19.1.1) (1.26.4)
Building wheels for collected packages: pystan
  Building wheel for pystan (setup.py) ... done
  Created wheel for pystan: filename=pystan-2.19.1.1-cp311-cp311-macosx_14_0_arm64.whl size=29357106 sha256=de67a0c028e4c1ff0d51adc447e9c5b91f09af3dadac9b30da187e1063d11ef8
  Stored in directory: /Users/liufang/Library/Caches/pip/wheels/64/c0/9d/4a4407389d24c0c0dbbc43a84039fcf77841f0312057281cfcc
Successfully built pystan
Installing collected packages: pystan
Successfully installed pystan-2.19.1.1
Requirement already satisfied: prophet in /opt/anaconda3/lib/python3.11/site-packages (1.1.5)
Requirement already satisfied: cmdstanpy>=1.0.4 in /opt/anaconda3/lib/python3.11/site-packages (from prophet) (1.2.4)
Requirement already satisfied: numpy>=1.15.4 in /opt/anaconda3/lib/python3.11/site-packages (from prophet) (1.26.4)
Requirement already satisfied: matplotlib>=2.0.0 in /opt/anaconda3/lib/python3.11/site-packages (from prophet) (3.8.0)
Requirement already satisfied: pandas>=1.0.4 in /opt/anaconda3/lib/python3.11/site-packages (from prophet) (2.1.4)
Requirement already satisfied: holidays>=0.25 in /opt/anaconda3/lib/python3.11/site-packages (from prophet) (0.53)
Requirement already satisfied: tqdm>=4.36.1 in /opt/anaconda3/lib/python3.11/site-packages (from prophet) (4.65.0)
Requirement already satisfied: importlib-resources in /opt/anaconda3/lib/python3.11/site-packages (from prophet) (6.4.0)
Requirement already satisfied: stанию<2.0.0,>=0.4.0 in /opt/anaconda3/lib/python3.11/site-packages (from cmdstanpy>=1.0.4->prophet) (0.5.1)
Requirement already satisfied: python-dateutil in /opt/anaconda3/lib/python3.11/site-packages (from holidays>=0.25->prophet) (2.8.2)
Requirement already satisfied: contourpy>=1.0.1 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->prophet) (1.2.0)
Requirement already satisfied: cycler>=0.10 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->prophet) (0.11.0)
```

```
Requirement already satisfied: fonttools>=4.22.0 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->prophet) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->prophet) (1.4.4)
Requirement already satisfied: packaging>=20.0 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->prophet) (23.1)
Requirement already satisfied: pillow>=6.2.0 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->prophet) (10.2.0)
Requirement already satisfied: pyparsing>=2.3.1 in /opt/anaconda3/lib/python3.11/site-packages (from matplotlib>=2.0.0->prophet) (3.0.9)
Requirement already satisfied: pytz>=2020.1 in /opt/anaconda3/lib/python3.11/site-packages (from pandas>=1.0.4->prophet) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in /opt/anaconda3/lib/python3.11/site-packages (from pandas>=1.0.4->prophet) (2023.3)
Requirement already satisfied: six>=1.5 in /opt/anaconda3/lib/python3.11/site-packages (from python-dateutil->holida
ys>=0.25->prophet) (1.16.0)
```

1.Data normalization and definition of model evaluation indicators and model dictionaries

```
In [40]: # 归一化
# 需要归一化的列
columns_to_scale = ['Weekly_Sales', 'Temperature', 'Fuel_Price', 'CPI', 'Unemployment', 'Size']

# 初始化一个字典来存储每个周的归一化器
scalers = {}

for week, df in data_frames.items():
    # 使用副本进行操作，避免改变原始数据
    df_scaled = df.copy()

    # 为每个周创建一个新的归一化器
    scaler = MinMaxScaler()
    df_scaled[columns_to_scale] = scaler.fit_transform(df_scaled[columns_to_scale])

    # 将归一化器存储在字典中
    scalers[week] = scaler

    # 更新归一化后的数据回字典
    data_frames[week] = df_scaled
```

```
# 查看归一化数据
print(f"Normalized data set for {week}:\n{df_scaled.head()}"")
```

Normalized data set for Weekly_Sales_2w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
1	1	1	2010-02-12	0.141019	1	0.396967	0.041712	
2	1	1	2010-02-19	0.128738	0	0.410861	0.023052	
3	1	1	2010-02-26	0.067409	0	0.476419	0.048847	
4	1	1	2010-03-05	0.074109	0	0.475147	0.083974	
5	1	1	2010-03-12	0.071941	0	0.585616	0.107025	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	
5	NaN	NaN	NaN	NaN	NaN	0.858193	

	Unemployment	Type	Size	Weekly_Sales_2w
1	0.390754	0	0.630267	41595.55
2	0.390754	0	0.630267	19403.54
3	0.390754	0	0.630267	21827.90
4	0.390754	0	0.630267	21043.39
5	0.390754	0	0.630267	22136.64

Normalized data set for Weekly_Sales_3w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.072609	0	0.434149	0.054885	
1	1	1	2010-02-12	0.123862	1	0.396967	0.041712	
2	1	1	2010-02-19	0.113075	0	0.410861	0.023052	
3	1	1	2010-02-26	0.059208	0	0.476419	0.048847	
4	1	1	2010-03-05	0.065093	0	0.475147	0.083974	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	

	Unemployment	Type	Size	Weekly_Sales_3w
0	0.390754	0	0.630267	41595.55
1	0.390754	0	0.630267	19403.54
2	0.390754	0	0.630267	21827.90
3	0.390754	0	0.630267	21043.39

4 0.390754 0 0.630267 22136.64

Normalized data set for Weekly_Sales_4w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.072609	0	0.434149	0.054885	
1	1	1	2010-02-12	0.123862	1	0.396967	0.041712	
2	1	1	2010-02-19	0.113075	0	0.410861	0.023052	
3	1	1	2010-02-26	0.059208	0	0.476419	0.048847	
4	1	1	2010-03-05	0.065093	0	0.475147	0.083974	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	

	Unemployment	Type	Size	Weekly_Sales_4w
0	0.390754	0	0.630267	19403.54
1	0.390754	0	0.630267	21827.90
2	0.390754	0	0.630267	21043.39
3	0.390754	0	0.630267	22136.64
4	0.390754	0	0.630267	26229.21

Normalized data set for Weekly_Sales_5w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.072609	0	0.434149	0.054885	
1	1	1	2010-02-12	0.123862	1	0.396967	0.041712	
2	1	1	2010-02-19	0.113075	0	0.410861	0.023052	
3	1	1	2010-02-26	0.059208	0	0.476419	0.048847	
5	1	1	2010-03-12	0.063189	0	0.585616	0.107025	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
5	NaN	NaN	NaN	NaN	NaN	0.858193	

	Unemployment	Type	Size	Weekly_Sales_5w
0	0.390754	0	0.630267	21827.90
1	0.390754	0	0.630267	21043.39
2	0.390754	0	0.630267	22136.64

3	0.390754	0	0.630267	26229.21
5	0.390754	0	0.630267	42960.91

Normalized data set for Weekly_Sales_6w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.072609	0	0.434149	0.054885	
1	1	1	2010-02-12	0.123862	1	0.396967	0.041712	
2	1	1	2010-02-19	0.113075	0	0.410861	0.023052	
4	1	1	2010-03-05	0.065093	0	0.475147	0.083974	
5	1	1	2010-03-12	0.063189	0	0.585616	0.107025	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
4	NaN	NaN	NaN	NaN	NaN	0.857886	
5	NaN	NaN	NaN	NaN	NaN	0.858193	

	Unemployment	Type	Size	Weekly_Sales_6w
0	0.390754	0	0.630267	21043.39
1	0.390754	0	0.630267	22136.64
2	0.390754	0	0.630267	26229.21
4	0.390754	0	0.630267	42960.91
5	0.390754	0	0.630267	17596.96

Normalized data set for Weekly_Sales_7w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.072609	0	0.434149	0.054885	
1	1	1	2010-02-12	0.123862	1	0.396967	0.041712	
3	1	1	2010-02-26	0.059208	0	0.476419	0.048847	
4	1	1	2010-03-05	0.065093	0	0.475147	0.083974	
5	1	1	2010-03-12	0.063189	0	0.585616	0.107025	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	
5	NaN	NaN	NaN	NaN	NaN	0.858193	

	Unemployment	Type	Size	Weekly_Sales_7w
0	0.390754	0	0.630267	22136.64
1	0.390754	0	0.630267	26229.21

3	0.390754	0	0.630267	42960.91
4	0.390754	0	0.630267	17596.96
5	0.390754	0	0.630267	16145.35

Normalized data set for Weekly_Sales_8w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.081926	0	0.434149	0.054885	
2	1	1	2010-02-19	0.127583	0	0.410861	0.023052	
3	1	1	2010-02-26	0.066805	0	0.476419	0.048847	
4	1	1	2010-03-05	0.073445	0	0.475147	0.083974	
5	1	1	2010-03-12	0.071296	0	0.585616	0.107025	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	
5	NaN	NaN	NaN	NaN	NaN	0.858193	

	Unemployment	Type	Size	Weekly_Sales_8w
0	0.390754	0	0.630267	26229.21
2	0.390754	0	0.630267	42960.91
3	0.390754	0	0.630267	17596.96
4	0.390754	0	0.630267	16145.35
5	0.390754	0	0.630267	16555.11

Normalized data set for Weekly_Sales_9w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
1	1	1	2010-02-12	0.141019	1	0.396967	0.041712	
2	1	1	2010-02-19	0.128738	0	0.410861	0.023052	
3	1	1	2010-02-26	0.067409	0	0.476419	0.048847	
4	1	1	2010-03-05	0.074109	0	0.475147	0.083974	
5	1	1	2010-03-12	0.071941	0	0.585616	0.107025	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	
5	NaN	NaN	NaN	NaN	NaN	0.858193	

	Unemployment	Type	Size	Weekly_Sales_9w
1	0.390754	0	0.630267	42960.91

2	0.390754	0	0.630267	17596.96
3	0.390754	0	0.630267	16145.35
4	0.390754	0	0.630267	16555.11
5	0.390754	0	0.630267	17413.94

Normalized data set for Weekly_Sales_10w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.080095	0	0.434149	0.054885	
1	1	1	2010-02-12	0.136632	1	0.396967	0.041712	
2	1	1	2010-02-19	0.124733	0	0.410861	0.023052	
3	1	1	2010-02-26	0.065313	0	0.476419	0.048847	
4	1	1	2010-03-05	0.071804	0	0.475147	0.083974	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	

	Unemployment	Type	Size	Weekly_Sales_10w
0	0.390754	0	0.630267	42960.91
1	0.390754	0	0.630267	17596.96
2	0.390754	0	0.630267	16145.35
3	0.390754	0	0.630267	16555.11
4	0.390754	0	0.630267	17413.94

Normalized data set for Weekly_Sales_11w:

	Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1	2010-02-05	0.082667	0	0.434149	0.054885	
1	1	1	2010-02-12	0.141019	1	0.396967	0.041712	
2	1	1	2010-02-19	0.128738	0	0.410861	0.023052	
3	1	1	2010-02-26	0.067409	0	0.476419	0.048847	
4	1	1	2010-03-05	0.074109	0	0.475147	0.083974	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	

	Unemployment	Type	Size	Weekly_Sales_11w
--	--------------	------	------	------------------

0	0.390754	0	0.630267		17596.96
1	0.390754	0	0.630267		16145.35
2	0.390754	0	0.630267		16555.11
3	0.390754	0	0.630267		17413.94
4	0.390754	0	0.630267		18926.74

Normalized data set for Weekly_Sales_12w:

Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1 2010-02-05	0.082667	0	0.434149	0.054885	
1	1	1 2010-02-12	0.141019	1	0.396967	0.041712	
2	1	1 2010-02-19	0.128738	0	0.410861	0.023052	
3	1	1 2010-02-26	0.067409	0	0.476419	0.048847	
4	1	1 2010-03-05	0.074109	0	0.475147	0.083974	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	

	Unemployment	Type	Size	Weekly_Sales_12w
0	0.390754	0	0.630267	16145.35
1	0.390754	0	0.630267	16555.11
2	0.390754	0	0.630267	17413.94
3	0.390754	0	0.630267	18926.74
4	0.390754	0	0.630267	14773.04

Normalized data set for Weekly_Sales_13w:

Store	Dept	Date	Weekly_Sales	IsHoliday	Temperature	Fuel_Price	\
0	1	1 2010-02-05	0.082667	0	0.434149	0.054885	
1	1	1 2010-02-12	0.141019	1	0.396967	0.041712	
2	1	1 2010-02-19	0.128738	0	0.410861	0.023052	
3	1	1 2010-02-26	0.067409	0	0.476419	0.048847	
4	1	1 2010-03-05	0.074109	0	0.475147	0.083974	

	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown5	CPI	\
0	NaN	NaN	NaN	NaN	NaN	0.855334	
1	NaN	NaN	NaN	NaN	NaN	0.856800	
2	NaN	NaN	NaN	NaN	NaN	0.857273	
3	NaN	NaN	NaN	NaN	NaN	0.857580	
4	NaN	NaN	NaN	NaN	NaN	0.857886	

	Unemployment	Type	Size	Weekly_Sales_13w
0	0.390754	0	0.630267	16555.11
1	0.390754	0	0.630267	17413.94
2	0.390754	0	0.630267	18926.74
3	0.390754	0	0.630267	14773.04
4	0.390754	0	0.630267	15580.43

```
In [42]: # Define a function to calculate the metrics including MSE|MAE|RMSE|R-square
```

```
def calculate_metrics(y_true,y_pred):
    mse=skm.mean_squared_error(y_true,y_pred)
    mae=skm.mean_absolute_error(y_true, y_pred)
    rmse=np.sqrt(mse)
    r2=skm.r2_score(y_true, y_pred)
    non_zero_idx = y_true != 0
    # Calculate MAPE
    mape = np.mean(np.abs((y_true[non_zero_idx] - y_pred[non_zero_idx]) / y_true[non_zero_idx])) * 100

    # Calculate SMAPE
    smape = 100 * np.mean(2 * np.abs(y_pred - y_true) / (np.abs(y_true) + np.abs(y_pred)))

    # Calculate MPE
    mpe = np.mean((y_true[non_zero_idx] - y_pred[non_zero_idx]) / y_true[non_zero_idx]) * 100

    return mse, mae, rmse, r2, mpe, mape, smape
```

```
In [139...]
```

```
# Create LSTM model
def create_lstm_model(input_shape):
    model = Sequential([
        Input(shape=input_shape),
        LSTM(50, activation='relu'),
        Dense(1)
    ])
    model.compile(optimizer='adam', loss='mean_squared_error')
    return model

# Create neural network model
def create_nn_model(input_dim):
    model = Sequential()
    model.add(Dense(128, activation='relu', input_shape=(input_dim,)))
    model.add(Dense(64, activation='relu'))
```

```
model.add(Dense(1))
model.compile(optimizer='adam', loss='mean_squared_error')
return model
```

```
In [46]: # Calculate the number of features for LSTM
# Add some other needed features
additional_features = ['Store', 'Dept', 'Type', 'IsHoliday']

num_features = len(columns_to_scale) + len(additional_features)
lstm_model = create_lstm_model((1, num_features))
```

```
In [90]: # Define the models dictionary
models = {
    'LR': LinearRegression(),
    'Ridge': Ridge(alpha=10.0),
    'Lasso': Lasso(alpha=0.1),
    'DT': DecisionTreeRegressor(max_depth=5, min_samples_split=50),
    'RF': RandomForestRegressor(n_estimators=200, max_depth=10, min_samples_split=10),
    'XGB': XGBRegressor(learning_rate=0.01, max_depth=10, n_estimators=500, subsample=0.8, colsample_bytree=0.8),
    'LSTM': create_lstm_model,
    'NN': create_nn_model
}
```

2. Load and split preprocessed data

3. Choose an algorithm

4. Train and test a model

5. Evaluate the model

```
In [92]: from joblib import dump

# 遍历每个DataFrame
for week, df in data_frames.items():
    # 获取当前周数, 假设 week 格式为 'Weekly_Sales_Xw'
    current_week = int(week.split('_')[2][:-1])
```

```
# 选择float64和int64类型的列
numerical_df = df.select_dtypes(include=['float64', 'int64'])

# 准备训练和测试数据
if f'Weekly_Sales_{current_week}w' in numerical_df.columns:
    y = numerical_df[f'Weekly_Sales_{current_week}w']
    # 删除所有不相关的销售周和预测列
    columns_to_drop = [col for col in numerical_df.columns if 'Weekly_Sales_' in col or 'Mark' in col]
    X = numerical_df.drop(columns=columns_to_drop)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=101)

print(f"Processing model for week {current_week}")

# 训练模型并进行预测
for model_name, model in models.items():
    # 为当前模型准备数据
    X_train_next, X_test_next = X_train.copy(), X_test.copy()
    if model_name == 'LSTM':
        # 重新初始化 LSTM 模型
        lstm_model = model((1, X_train_next.shape[1]))
        X_train_reshaped = X_train_next.values.reshape((-1, 1, X_train_next.shape[1]))
        X_test_reshaped = X_test_next.values.reshape((-1, 1, X_test_next.shape[1]))
        lstm_model.fit(X_train_reshaped, y_train, epochs=50, verbose=0)
        y_train_pred = lstm_model.predict(X_train_reshaped).flatten()
        y_test_pred = lstm_model.predict(X_test_reshaped).flatten()
        model_to_save = lstm_model
    elif model_name == 'NN':
        # 重新初始化 NN 模型
        nn_model = model(X_train_next.shape[1])
        nn_model.fit(X_train_next, y_train, epochs=50, verbose=0)
        y_train_pred = nn_model.predict(X_train_next).flatten()
        y_test_pred = nn_model.predict(X_test_next).flatten()
        model_to_save = nn_model
    else:
        model.fit(X_train_next, y_train)
        y_train_pred = model.predict(X_train_next)
        y_test_pred = model.predict(X_test_next)
        model_to_save = model
    # 组合模型名和周数，创建唯一的文件名
```

```
filename = f'model_{model_name}_{current_week}w.joblib'
# 保存模型到指定的文件
dump(model_to_save, filename)

# 计算并打印评估指标
mse, mae, rmse, r2, mpe, smape, mape = calculate_metrics(y_train, y_train_pred)
print(f"Week {current_week}, Model {model_name} - Training Metrics: MSE={mse:.2f}, MAE={mae:.2f}, RMSE={rmse:.2f}, R2={r2:.2f}, MPE={mpe:.2f}, SMAPE={smape:.2f}, MAPE={mape:.2f}")

mse, mae, rmse, r2, mpe, smape, mape = calculate_metrics(y_test, y_test_pred)
print(f"Week {current_week}, Model {model_name} - Testing Metrics: MSE={mse:.2f}, MAE={mae:.2f}, RMSE={rmse:.2f}, R2={r2:.2f}, MPE={mpe:.2f}, SMAPE={smape:.2f}, MAPE={mape:.2f}")

# 更新 data_frames 字典
data_frames[week] = df
```

Processing model for week 2

Week 2, Model LR - Training Metrics: MSE=14987968.02, MAE=1976.03, RMSE=3871.43, R2=0.864, MPE=-31.765%, SMAPE=41.734%, MAPE=27.573%

Week 2, Model LR - Testing Metrics: MSE=17054201.78, MAE=1982.27, RMSE=4129.67, R2=0.846, MPE=-31.884%, SMAPE=41.772%, MAPE=27.672%

Week 2, Model Ridge - Training Metrics: MSE=15233287.33, MAE=2200.60, RMSE=3902.98, R2=0.862, MPE=-42.113%, SMAPE=52.303%, MAPE=31.662%

Week 2, Model Ridge - Testing Metrics: MSE=17072403.20, MAE=2206.92, RMSE=4131.88, R2=0.846, MPE=-42.329%, SMAPE=52.413%, MAPE=31.788%

Week 2, Model Lasso - Training Metrics: MSE=14987979.89, MAE=1977.31, RMSE=3871.43, R2=0.864, MPE=-31.834%, SMAPE=41.801%, MAPE=27.600%

Week 2, Model Lasso - Testing Metrics: MSE=17052659.70, MAE=1983.56, RMSE=4129.49, R2=0.846, MPE=-31.954%, SMAPE=41.840%, MAPE=27.700%

Week 2, Model DT - Training Metrics: MSE=7989378.34, MAE=1549.58, RMSE=2826.55, R2=0.927, MPE=-8.837%, SMAPE=21.183%, MAPE=17.902%

Week 2, Model DT - Testing Metrics: MSE=7997686.45, MAE=1547.16, RMSE=2828.02, R2=0.928, MPE=-8.689%, SMAPE=21.048%, MAPE=17.934%

Week 2, Model RF - Training Metrics: MSE=6691806.38, MAE=1440.25, RMSE=2586.85, R2=0.939, MPE=-7.538%, SMAPE=18.880%, MAPE=16.133%

Week 2, Model RF - Testing Metrics: MSE=7334544.54, MAE=1480.78, RMSE=2708.24, R2=0.934, MPE=-7.643%, SMAPE=19.227%, MAPE=16.464%

Week 2, Model XGB - Training Metrics: MSE=4439029.32, MAE=1233.66, RMSE=2106.90, R2=0.960, MPE=-8.403%, SMAPE=17.616%, MAPE=14.973%

Week 2, Model XGB - Testing Metrics: MSE=5777510.30, MAE=1358.23, RMSE=2403.65, R2=0.948, MPE=-9.001%, SMAPE=18.821%, MAPE=15.916%

6051/6051  2s 265us/step

2594/2594  1s 276us/step

Week 2, Model LSTM - Training Metrics: MSE=8536014.69, MAE=1672.38, RMSE=2921.65, R2=0.922, MPE=-5.203%, SMAPE=26.507%, MAPE=24.099%

Week 2, Model LSTM - Testing Metrics: MSE=8566003.58, MAE=1671.75, RMSE=2926.77, R2=0.923, MPE=-5.027%, SMAPE=26.349%, MAPE=24.141%

/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.

```
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 ————— **1s** 214us/step

2594/2594 ————— **1s** 227us/step

Week 2, Model NN – Training Metrics: MSE=7781139.28, MAE=1605.76, RMSE=2789.47, R2=0.929, MPE=-20.459%, SMAPE=28.127%, MAPE=21.147%

Week 2, Model NN – Testing Metrics: MSE=7792903.25, MAE=1603.72, RMSE=2791.58, R2=0.930, MPE=-20.356%, SMAPE=27.998%, MAPE=21.174%

Processing model for week 3

Week 3, Model LR – Training Metrics: MSE=25066885.37, MAE=2699.71, RMSE=5006.68, R2=0.772, MPE=-52.747%, SMAPE=65.041%, MAPE=36.455%

Week 3, Model LR – Testing Metrics: MSE=24317417.63, MAE=2700.60, RMSE=4931.27, R2=0.781, MPE=-52.826%, SMAPE=64.927%, MAPE=36.549%

Week 3, Model Ridge – Training Metrics: MSE=25361976.26, MAE=2958.76, RMSE=5036.07, R2=0.770, MPE=-63.536%, SMAPE=76.398%, MAPE=39.980%

Week 3, Model Ridge – Testing Metrics: MSE=24718523.20, MAE=2960.48, RMSE=4971.77, R2=0.777, MPE=-63.652%, SMAPE=76.315%, MAPE=40.103%

Week 3, Model Lasso – Training Metrics: MSE=25066899.04, MAE=2701.26, RMSE=5006.69, R2=0.772, MPE=-52.819%, SMAPE=65.114%, MAPE=36.479%

Week 3, Model Lasso – Testing Metrics: MSE=24318093.64, MAE=2702.16, RMSE=4931.34, R2=0.781, MPE=-52.898%, SMAPE=65.001%, MAPE=36.573%

Week 3, Model DT – Training Metrics: MSE=11401212.15, MAE=1887.15, RMSE=3376.57, R2=0.896, MPE=-13.236%, SMAPE=26.740%, MAPE=21.164%

Week 3, Model DT – Testing Metrics: MSE=11869548.57, MAE=1902.81, RMSE=3445.22, R2=0.893, MPE=-13.138%, SMAPE=26.643%, MAPE=21.218%

Week 3, Model RF – Training Metrics: MSE=9102145.47, MAE=1713.28, RMSE=3016.98, R2=0.917, MPE=-11.408%, SMAPE=24.059%, MAPE=19.229%

Week 3, Model RF – Testing Metrics: MSE=10377136.05, MAE=1779.27, RMSE=3221.36, R2=0.906, MPE=-11.834%, SMAPE=24.652%, MAPE=19.634%

Week 3, Model XGB – Training Metrics: MSE=5594370.84, MAE=1407.41, RMSE=2365.24, R2=0.949, MPE=-10.828%, SMAPE=20.982%, MAPE=17.150%

Week 3, Model XGB – Testing Metrics: MSE=7409555.27, MAE=1555.54, RMSE=2722.05, R2=0.933, MPE=-11.813%, SMAPE=22.572%, MAPE=18.266%

6051/6051 ————— **2s** 262us/step

2594/2594 ————— **1s** 280us/step

Week 3, Model LSTM – Training Metrics: MSE=12353936.55, MAE=2043.52, RMSE=3514.82, R2=0.888, MPE=-17.774%, SMAPE=33.527%, MAPE=25.783%

Week 3, Model LSTM – Testing Metrics: MSE=12777186.64, MAE=2053.83, RMSE=3574.52, R2=0.885, MPE=-17.921%, SMAPE=33.397%, MAPE=25.767%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 ————— **1s** 227us/step

2594/2594 ————— **1s** 216us/step

Week 3, Model NN – Training Metrics: MSE=10734084.15, MAE=1862.35, RMSE=3276.29, R2=0.903, MPE=-17.841%, SMAPE=29.338%, MAPE=22.215%

Week 3, Model NN – Testing Metrics: MSE=11158892.16, MAE=1875.44, RMSE=3340.49, R2=0.899, MPE=-17.888%, SMAPE=29.260%, MAPE=22.246%

Processing model for week 4

Week 4, Model LR – Training Metrics: MSE=28404982.71, MAE=2986.91, RMSE=5329.63, R2=0.743, MPE=-58.676%, SMAPE=72.148%, MAPE=39.132%

Week 4, Model LR – Testing Metrics: MSE=29740796.99, MAE=2979.18, RMSE=5453.51, R2=0.731, MPE=-58.768%, SMAPE=72.176%, MAPE=39.219%

Week 4, Model Ridge – Training Metrics: MSE=28676338.80, MAE=3225.12, RMSE=5355.03, R2=0.740, MPE=-68.882%, SMAPE=82.854%, MAPE=42.258%

Week 4, Model Ridge – Testing Metrics: MSE=29831516.58, MAE=3218.91, RMSE=5461.82, R2=0.730, MPE=-69.039%, SMAPE=82.940%, MAPE=42.365%

Week 4, Model Lasso – Training Metrics: MSE=28404996.08, MAE=2988.39, RMSE=5329.63, R2=0.743, MPE=-58.746%, SMAPE=72.220%, MAPE=39.153%

Week 4, Model Lasso – Testing Metrics: MSE=29739578.75, MAE=2980.67, RMSE=5453.40, R2=0.731, MPE=-58.839%, SMAPE=72.248%, MAPE=39.241%

Week 4, Model DT – Training Metrics: MSE=13863171.03, MAE=2084.47, RMSE=3723.33, R2=0.875, MPE=-16.632%, SMAPE=30.687%, MAPE=23.520%

Week 4, Model DT – Testing Metrics: MSE=13661793.16, MAE=2086.57, RMSE=3696.19, R2=0.876, MPE=-16.657%, SMAPE=30.730%, MAPE=23.645%

Week 4, Model RF – Training Metrics: MSE=10721783.49, MAE=1878.52, RMSE=3274.41, R2=0.903, MPE=-14.030%, SMAPE=27.324%, MAPE=21.211%

Week 4, Model RF – Testing Metrics: MSE=11434670.97, MAE=1933.54, RMSE=3381.52, R2=0.897, MPE=-14.704%, SMAPE=28.271%, MAPE=21.767%

Week 4, Model XGB – Training Metrics: MSE=6208687.70, MAE=1489.00, RMSE=2491.72, R2=0.944, MPE=-12.302%, SMAPE=22.796%, MAPE=18.309%

Week 4, Model XGB – Testing Metrics: MSE=7837220.54, MAE=1641.93, RMSE=2799.50, R2=0.929, MPE=-13.733%, SMAPE=24.940%, MAPE=19.659%

6051/6051 ————— **2s** 257us/step

2594/2594 ————— **1s** 276us/step

Week 4, Model LSTM – Training Metrics: MSE=14998117.67, MAE=2282.67, RMSE=3872.74, R2=0.864, MPE=-27.927%, SMAPE=40.747%, MAPE=28.224%

Week 4, Model LSTM – Testing Metrics: MSE=14717424.99, MAE=2275.70, RMSE=3836.33, R2=0.867, MPE=-28.073%, SMAPE=40.749%, MAPE=28.274%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 ————— **1s** 230us/step

2594/2594 ————— **1s** 215us/step

Week 4, Model NN – Training Metrics: MSE=13848047.85, MAE=2277.18, RMSE=3721.30, R2=0.875, MPE=-36.447%, SMAPE=45.232%, MAPE=29.715%

Week 4, Model NN – Testing Metrics: MSE=13587525.03, MAE=2273.25, RMSE=3686.13, R2=0.877, MPE=-36.504%, SMAPE=45.323%, MAPE=29.843%

Processing model for week 5

Week 5, Model LR – Training Metrics: MSE=31222899.22, MAE=3179.68, RMSE=5587.75, R2=0.718, MPE=-64.594%, SMAPE=78.789%, MAPE=41.151%

Week 5, Model LR – Testing Metrics: MSE=28886719.60, MAE=3156.93, RMSE=5374.64, R2=0.740, MPE=-63.943%, SMAPE=78.049%, MAPE=41.092%

Week 5, Model Ridge – Training Metrics: MSE=31474697.46, MAE=3413.11, RMSE=5610.23, R2=0.716, MPE=-74.278%, SMAPE=88.981%, MAPE=44.007%

Week 5, Model Ridge – Testing Metrics: MSE=29390685.06, MAE=3390.63, RMSE=5421.32, R2=0.735, MPE=-73.635%, SMAPE=88.238%, MAPE=43.964%

Week 5, Model Lasso – Training Metrics: MSE=31222912.57, MAE=3181.17, RMSE=5587.75, R2=0.718, MPE=-64.662%, SMAPE=78.859%, MAPE=41.171%

Week 5, Model Lasso – Testing Metrics: MSE=28888485.64, MAE=3158.43, RMSE=5374.80, R2=0.740, MPE=-64.011%, SMAPE=78.119%, MAPE=41.112%

Week 5, Model DT – Training Metrics: MSE=15005850.29, MAE=2177.39, RMSE=3873.74, R2=0.865, MPE=-19.477%, SMAPE=33.843%, MAPE=25.065%

Week 5, Model DT – Testing Metrics: MSE=14919704.27, MAE=2171.63, RMSE=3862.60, R2=0.866, MPE=-18.962%, SMAPE=33.368%, MAPE=25.055%

Week 5, Model RF – Training Metrics: MSE=11049732.96, MAE=1912.64, RMSE=3324.11, R2=0.900, MPE=-15.711%, SMAPE=29.252%, MAPE=22.158%

Week 5, Model RF – Testing Metrics: MSE=12278964.78, MAE=1983.15, RMSE=3504.14, R2=0.889, MPE=-15.951%, SMAPE=29.855%, MAPE=22.668%

Week 5, Model XGB – Training Metrics: MSE=6180777.53, MAE=1491.13, RMSE=2486.12, R2=0.944, MPE=-13.306%, SMAPE=23.894%, MAPE=18.856%

Week 5, Model XGB – Testing Metrics: MSE=8265813.54, MAE=1662.27, RMSE=2875.03, R2=0.926, MPE=-14.452%, SMAPE=25.838%, MAPE=20.154%

6051/6051 ————— **2s** 257us/step

2594/2594 ————— **1s** 278us/step

Week 5, Model LSTM – Training Metrics: MSE=16346646.39, MAE=2396.11, RMSE=4043.10, R2=0.852, MPE=-3.695%, SMAPE=38.640%, MAPE=34.211%

Week 5, Model LSTM – Testing Metrics: MSE=16167683.25, MAE=2383.74, RMSE=4020.91, R2=0.854, MPE=-3.581%, SMAPE=38.005%, MAPE=33.900%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 ————— **1s** 210us/step

2594/2594 ————— **1s** 212us/step

Week 5, Model NN – Training Metrics: MSE=14600201.47, MAE=2153.52, RMSE=3821.02, R2=0.868, MPE=-12.982%, SMAPE=31.499%, MAPE=24.604%

Week 5, Model NN – Testing Metrics: MSE=14553518.23, MAE=2148.64, RMSE=3814.91, R2=0.869, MPE=-12.522%, SMAPE=31.107%, MAPE=24.612%

Processing model for week 6

Week 6, Model LR – Training Metrics: MSE=35170702.32, MAE=3491.55, RMSE=5930.49, R2=0.683, MPE=-72.812%, SMAPE=88.081%, MAPE=44.051%

Week 6, Model LR – Testing Metrics: MSE=31632591.64, MAE=3459.52, RMSE=5624.29, R2=0.715, MPE=-72.644%, SMAPE=87.846%, MAPE=44.210%

Week 6, Model Ridge – Training Metrics: MSE=35387706.25, MAE=3700.75, RMSE=5948.76, R2=0.681, MPE=-81.557%, SMAPE=97.291%, MAPE=46.478%

Week 6, Model Ridge – Testing Metrics: MSE=32227823.83, MAE=3670.30, RMSE=5676.96, R2=0.709, MPE=-81.498%, SMAPE=97.152%, MAPE=46.658%

Week 6, Model Lasso – Training Metrics: MSE=35170714.89, MAE=3492.97, RMSE=5930.49, R2=0.683, MPE=-72.877%, SMAPE=88.148%, MAPE=44.069%

Week 6, Model Lasso – Testing Metrics: MSE=31635320.22, MAE=3460.95, RMSE=5624.53, R2=0.715, MPE=-72.709%, SMAPE=87.914%, MAPE=44.228%

Week 6, Model DT – Training Metrics: MSE=17454177.22, MAE=2383.64, RMSE=4177.82, R2=0.843, MPE=-22.546%, SMAPE=37.439%, MAPE=27.164%

Week 6, Model DT – Testing Metrics: MSE=17377508.02, MAE=2380.77, RMSE=4168.63, R2=0.843, MPE=-21.995%, SMAPE=36.997%, MAPE=27.243%

Week 6, Model RF – Training Metrics: MSE=12536905.57, MAE=2066.98, RMSE=3540.75, R2=0.887, MPE=-17.820%, SMAPE=31.896%, MAPE=23.854%

Week 6, Model RF – Testing Metrics: MSE=13570766.98, MAE=2135.35, RMSE=3683.85, R2=0.878, MPE=-18.084%, SMAPE=32.544%, MAPE=24.376%

Week 6, Model XGB – Training Metrics: MSE=6927248.86, MAE=1580.09, RMSE=2631.97, R2=0.938, MPE=-14.533%, SMAPE=25.419%, MAPE=19.849%

Week 6, Model XGB – Testing Metrics: MSE=8835362.83, MAE=1750.45, RMSE=2972.43, R2=0.920, MPE=-15.839%, SMAPE=27.603%, MAPE=21.231%

6052/6052 ————— **2s** 275us/step

2594/2594 ————— **1s** 258us/step

Week 6, Model LSTM – Training Metrics: MSE=18186189.67, MAE=2508.42, RMSE=4264.53, R2=0.836, MPE=-3.223%, SMAPE=37.095%, MAPE=33.478%

Week 6, Model LSTM – Testing Metrics: MSE=18064813.82, MAE=2499.89, RMSE=4250.27, R2=0.837, MPE=-2.761%, SMAPE=36.693%, MAPE=33.524%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6052/6052 ————— **1s** 221us/step

2594/2594 ————— **1s** 209us/step

Week 6, Model NN – Training Metrics: MSE=16529697.49, MAE=2354.90, RMSE=4065.67, R2=0.851, MPE=-15.281%, SMAPE=37.182%, MAPE=29.313%

Week 6, Model NN – Testing Metrics: MSE=16513161.22, MAE=2351.51, RMSE=4063.64, R2=0.851, MPE=-14.810%, SMAPE=36.876%, MAPE=29.446%

Processing model for week 7

Week 7, Model LR – Training Metrics: MSE=35562538.60, MAE=3549.83, RMSE=5963.43, R2=0.680, MPE=-73.347%, SMAPE=88.902%, MAPE=44.523%

Week 7, Model LR – Testing Metrics: MSE=37026698.80, MAE=3575.29, RMSE=6084.96, R2=0.668, MPE=-74.349%, SMAPE=89.867%, MAPE=44.823%

Week 7, Model Ridge – Training Metrics: MSE=35778261.52, MAE=3752.06, RMSE=5981.49, R2=0.678, MPE=-82.054%, SMAPE=98.034%, MAPE=46.896%

Week 7, Model Ridge – Testing Metrics: MSE=37068159.21, MAE=3776.34, RMSE=6088.36, R2=0.667, MPE=-83.102%, SMAPE=99.041%, MAPE=47.202%

Week 7, Model Lasso – Training Metrics: MSE=35562551.17, MAE=3551.20, RMSE=5963.43, R2=0.680, MPE=-73.411%, SMAPE=88.969%, MAPE=44.541%

Week 7, Model Lasso – Testing Metrics: MSE=37025443.97, MAE=3576.65, RMSE=6084.85, R2=0.668, MPE=-74.414%, SMAPE=89.934%, MAPE=44.841%

Week 7, Model DT – Training Metrics: MSE=18500374.51, MAE=2517.39, RMSE=4301.21, R2=0.834, MPE=-25.155%, SMAPE=41.131%, MAPE=29.104%

Week 7, Model DT – Testing Metrics: MSE=18856171.76, MAE=2542.73, RMSE=4342.37, R2=0.831, MPE=-26.034%, SMAPE=41.999%, MAPE=29.427%

Week 7, Model RF – Training Metrics: MSE=13114803.61, MAE=2160.56, RMSE=3621.44, R2=0.882, MPE=-18.418%, SMAPE=32.931%, MAPE=24.900%

Week 7, Model RF – Testing Metrics: MSE=14441267.66, MAE=2250.81, RMSE=3800.17, R2=0.870, MPE=-20.079%, SMAPE=34.822%, MAPE=25.729%

Week 7, Model XGB – Training Metrics: MSE=7316232.04, MAE=1646.28, RMSE=2704.85, R2=0.934, MPE=-15.117%, SMAPE=26.343%, MAPE=20.556%

Week 7, Model XGB – Testing Metrics: MSE=9527451.57, MAE=1836.16, RMSE=3086.66, R2=0.914, MPE=-17.459%, SMAPE=29.454%, MAPE=22.210%

6051/6051 ————— **2s** 269us/step

2594/2594 ————— **1s** 275us/step

Week 7, Model LSTM – Training Metrics: MSE=20805932.15, MAE=2951.50, RMSE=4561.35, R2=0.813, MPE=-45.080%, SMAPE=60.739%, MAPE=37.413%

Week 7, Model LSTM – Testing Metrics: MSE=21039527.03, MAE=2968.18, RMSE=4586.89, R2=0.811, MPE=-45.973%, SMAPE=61.585%, MAPE=37.637%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 ————— **1s** 228us/step

2594/2594 ————— **1s** 216us/step

Week 7, Model NN – Training Metrics: MSE=17897849.61, MAE=2500.99, RMSE=4230.59, R2=0.839, MPE=-12.917%, SMAPE=36.389%, MAPE=29.236%

Week 7, Model NN – Testing Metrics: MSE=18193286.92, MAE=2527.38, RMSE=4265.36, R2=0.837, MPE=-13.785%, SMAPE=37.260%, MAPE=29.569%

Processing model for week 8

Week 8, Model LR – Training Metrics: MSE=36801764.81, MAE=3651.98, RMSE=6066.45, R2=0.669, MPE=-76.501%, SMAPE=92.345%, MAPE=45.543%

Week 8, Model LR – Testing Metrics: MSE=36492681.15, MAE=3655.69, RMSE=6040.92, R2=0.673, MPE=-76.337%, SMAPE=92.271%, MAPE=45.709%

Week 8, Model Ridge – Training Metrics: MSE=36930161.80, MAE=3805.51, RMSE=6077.02, R2=0.668, MPE=-83.175%, SMAPE=99.350%, MAPE=47.330%

Week 8, Model Ridge – Testing Metrics: MSE=36688828.46, MAE=3808.61, RMSE=6057.13, R2=0.671, MPE=-83.047%, SMAPE=99.280%, MAPE=47.483%

Week 8, Model Lasso – Training Metrics: MSE=36801774.85, MAE=3653.18, RMSE=6066.45, R2=0.669, MPE=-76.558%, SMAPE=92.403%, MAPE=45.558%

Week 8, Model Lasso – Testing Metrics: MSE=36493204.57, MAE=3656.87, RMSE=6040.96, R2=0.673, MPE=-76.394%, SMAPE=92.329%, MAPE=45.724%

Week 8, Model DT – Training Metrics: MSE=18822734.95, MAE=2549.62, RMSE=4338.52, R2=0.831, MPE=-25.995%, SMAPE=42.018%, MAPE=29.365%

Week 8, Model DT – Testing Metrics: MSE=19394872.42, MAE=2567.29, RMSE=4403.96, R2=0.826, MPE=-25.622%, SMAPE=41.985%, MAPE=29.596%

Week 8, Model RF – Training Metrics: MSE=13277458.17, MAE=2190.71, RMSE=3643.82, R2=0.881, MPE=-19.412%, SMAPE=34.067%, MAPE=25.416%

Week 8, Model RF – Testing Metrics: MSE=14944319.05, MAE=2287.91, RMSE=3865.79, R2=0.866, MPE=-19.938%, SMAPE=35.220%, MAPE=26.219%

Week 8, Model XGB – Training Metrics: MSE=7439507.08, MAE=1665.00, RMSE=2727.55, R2=0.933, MPE=-15.916%, SMAPE=27.228%, MAPE=20.960%

Week 8, Model XGB – Testing Metrics: MSE=9919600.17, MAE=1870.25, RMSE=3149.54, R2=0.911, MPE=-17.278%, SMAPE=29.693%, MAPE=22.607%

6051/6051 ————— **2s** 268us/step

2594/2594 ————— **1s** 275us/step

Week 8, Model LSTM – Training Metrics: MSE=21696734.68, MAE=3011.29, RMSE=4657.98, R2=0.805, MPE=-7.444%, SMAPE=57.838%, MAPE=46.539%

Week 8, Model LSTM – Testing Metrics: MSE=22128014.94, MAE=3025.53, RMSE=4704.04, R2=0.802, MPE=-7.058%, SMAPE=57.725%, MAPE=46.770%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 ————— **1s** 210us/step

2594/2594 ————— **1s** 214us/step

Week 8, Model NN – Training Metrics: MSE=18258801.26, MAE=2525.45, RMSE=4273.03, R2=0.836, MPE=-24.611%, SMAPE=41.527%, MAPE=29.424%

Week 8, Model NN – Testing Metrics: MSE=18813265.33, MAE=2547.25, RMSE=4337.43, R2=0.831, MPE=-24.285%, SMAPE=41.543%, MAPE=29.689%

Processing model for week 9

Week 9, Model LR – Training Metrics: MSE=34646946.82, MAE=3541.57, RMSE=5886.17, R2=0.690, MPE=-71.289%, SMAPE=86.926%, MAPE=44.229%

Week 9, Model LR – Testing Metrics: MSE=37269098.93, MAE=3551.97, RMSE=6104.84, R2=0.666, MPE=-72.553%, SMAPE=87.880%, MAPE=44.463%

Week 9, Model Ridge – Training Metrics: MSE=34786449.36, MAE=3697.76, RMSE=5898.00, R2=0.689, MPE=-78.374%, SMAPE=94.297%, MAPE=46.150%

Week 9, Model Ridge – Testing Metrics: MSE=37137661.45, MAE=3705.88, RMSE=6094.07, R2=0.667, MPE=-79.698%, SMAPE=95.296%, MAPE=46.392%

Week 9, Model Lasso – Training Metrics: MSE=34646957.04, MAE=3542.74, RMSE=5886.17, R2=0.690, MPE=-71.348%, SMAPE=86.986%, MAPE=44.245%

Week 9, Model Lasso – Testing Metrics: MSE=37267096.78, MAE=3553.13, RMSE=6104.68, R2=0.666, MPE=-72.612%, SMAPE=87.940%, MAPE=44.479%

Week 9, Model DT – Training Metrics: MSE=19528164.97, MAE=2616.56, RMSE=4419.07, R2=0.825, MPE=-28.200%, SMAPE=44.601%, MAPE=30.545%

Week 9, Model DT – Testing Metrics: MSE=19800348.03, MAE=2624.02, RMSE=4449.76, R2=0.823, MPE=-28.808%, SMAPE=45.203%, MAPE=30.791%

Week 9, Model RF – Training Metrics: MSE=13438336.46, MAE=2202.58, RMSE=3665.83, R2=0.880, MPE=-20.512%, SMAPE=35.166%, MAPE=25.818%

Week 9, Model RF – Testing Metrics: MSE=14924862.23, MAE=2282.45, RMSE=3863.27, R2=0.866, MPE=-21.786%, SMAPE=36.675%, MAPE=26.590%

Week 9, Model XGB – Training Metrics: MSE=7584119.19, MAE=1679.39, RMSE=2753.93, R2=0.932, MPE=-16.472%, SMAPE=27.814%, MAPE=21.166%

Week 9, Model XGB – Testing Metrics: MSE=9999365.29, MAE=1865.45, RMSE=3162.18, R2=0.910, MPE=-18.476%, SMAPE=30.614%, MAPE=22.816%

6052/6052 ————— **2s** 264us/step

2594/2594 ————— **1s** 256us/step

Week 9, Model LSTM – Training Metrics: MSE=20763554.06, MAE=2915.68, RMSE=4556.70, R2=0.814, MPE=-50.127%, SMAPE=60.918%, MAPE=36.607%

Week 9, Model LSTM – Testing Metrics: MSE=21165332.09, MAE=2928.62, RMSE=4600.58, R2=0.810, MPE=-50.908%, SMAPE=61.617%, MAPE=36.882%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6052/6052 ————— **1s** 212us/step

2594/2594 ————— **1s** 211us/step

Week 9, Model NN – Training Metrics: MSE=18949647.33, MAE=2573.95, RMSE=4353.12, R2=0.831, MPE=-17.869%, SMAPE=39.402%, MAPE=30.104%

Week 9, Model NN – Testing Metrics: MSE=19280988.20, MAE=2577.83, RMSE=4391.01, R2=0.827, MPE=-18.622%, SMAPE=39.990%, MAPE=30.320%

Processing model for week 10

Week 10, Model LR – Training Metrics: MSE=36452774.62, MAE=3661.65, RMSE=6037.61, R2=0.674, MPE=-75.147%, SMAPE=91.169%, MAPE=45.427%

Week 10, Model LR – Testing Metrics: MSE=37550047.31, MAE=3657.83, RMSE=6127.81, R2=0.663, MPE=-76.007%, SMAPE=91.865%, MAPE=45.530%

Week 10, Model Ridge – Training Metrics: MSE=36600885.06, MAE=3824.46, RMSE=6049.87, R2=0.673, MPE=-82.396%, SMAPE=98.732%, MAPE=47.356%

Week 10, Model Ridge – Testing Metrics: MSE=37549164.36, MAE=3818.90, RMSE=6127.74, R2=0.663, MPE=-83.271%, SMAPE=99.425%, MAPE=47.451%

Week 10, Model Lasso – Training Metrics: MSE=36452785.25, MAE=3662.87, RMSE=6037.61, R2=0.674, MPE=-75.207%, SMAPE=91.229%, MAPE=45.443%

Week 10, Model Lasso – Testing Metrics: MSE=37548833.73, MAE=3659.04, RMSE=6127.71, R2=0.663, MPE=-76.066%, SMAPE=91.925%, MAPE=45.546%

Week 10, Model DT – Training Metrics: MSE=20447852.70, MAE=2663.31, RMSE=4521.93, R2=0.817, MPE=-29.995%, SMAPE=46.386%, MAPE=31.236%

Week 10, Model DT – Testing Metrics: MSE=20060390.59, MAE=2657.66, RMSE=4478.88, R2=0.820, MPE=-30.632%, SMAPE=46.981%, MAPE=31.432%

Week 10, Model RF – Training Metrics: MSE=13984616.41, MAE=2233.37, RMSE=3739.60, R2=0.875, MPE=-21.714%, SMAPE=36.378%, MAPE=26.301%

Week 10, Model RF – Testing Metrics: MSE=14923736.82, MAE=2301.71, RMSE=3863.13, R2=0.866, MPE=-23.224%, SMAPE=38.101%, MAPE=27.061%

Week 10, Model XGB – Training Metrics: MSE=7768190.47, MAE=1688.59, RMSE=2787.15, R2=0.931, MPE=-17.092%, SMAPE=28.467%, MAPE=21.503%

Week 10, Model XGB – Testing Metrics: MSE=9764313.55, MAE=1863.25, RMSE=3124.79, R2=0.912, MPE=-19.478%, SMAPE=31.517%, MAPE=23.088%

6051/6051 ————— **2s** 262us/step

2594/2594 ————— **1s** 277us/step

Week 10, Model LSTM – Training Metrics: MSE=20935470.44, MAE=2717.49, RMSE=4575.53, R2=0.813, MPE=-31.491%, SMAPE=48.357%, MAPE=32.365%

Week 10, Model LSTM – Testing Metrics: MSE=20527593.60, MAE=2705.81, RMSE=4530.74, R2=0.816, MPE=-32.212%, SMAPE=48.935%, MAPE=32.490%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 _____ 1s 218us/step

2594/2594 _____ 1s 219us/step

Week 10, Model NN - Training Metrics: MSE=20034507.48, MAE=2603.03, RMSE=4475.99, R2=0.821, MPE=-9.579%, SMAPE=37.743%, MAPE=31.356%

Week 10, Model NN - Testing Metrics: MSE=19617385.04, MAE=2590.43, RMSE=4429.15, R2=0.824, MPE=-10.288%, SMAPE=38.146%, MAPE=31.351%

Processing model for week 11

Week 11, Model LR - Training Metrics: MSE=35965708.80, MAE=3664.10, RMSE=5997.14, R2=0.678, MPE=-74.453%, SMAPE=90.590%, MAPE=45.403%

Week 11, Model LR - Testing Metrics: MSE=36739900.64, MAE=3661.35, RMSE=6061.34, R2=0.671, MPE=-74.378%, SMAPE=90.186%, MAPE=45.423%

Week 11, Model Ridge - Training Metrics: MSE=36101627.11, MAE=3813.25, RMSE=6008.46, R2=0.677, MPE=-81.456%, SMAPE=97.852%, MAPE=47.232%

Week 11, Model Ridge - Testing Metrics: MSE=36751088.92, MAE=3810.05, RMSE=6062.27, R2=0.670, MPE=-81.389%, SMAPE=97.460%, MAPE=47.274%

Week 11, Model Lasso - Training Metrics: MSE=35965719.00, MAE=3665.23, RMSE=5997.14, R2=0.678, MPE=-74.511%, SMAPE=90.649%, MAPE=45.418%

Week 11, Model Lasso - Testing Metrics: MSE=36738811.56, MAE=3662.47, RMSE=6061.25, R2=0.671, MPE=-74.437%, SMAPE=90.245%, MAPE=45.439%

Week 11, Model DT - Training Metrics: MSE=21435493.81, MAE=2770.46, RMSE=4629.85, R2=0.808, MPE=-31.651%, SMAPE=48.363%, MAPE=32.209%

Week 11, Model DT - Testing Metrics: MSE=21301146.88, MAE=2766.52, RMSE=4615.32, R2=0.809, MPE=-31.690%, SMAPE=48.243%, MAPE=32.202%

Week 11, Model RF - Training Metrics: MSE=14497089.38, MAE=2309.02, RMSE=3807.50, R2=0.870, MPE=-22.467%, SMAPE=37.493%, MAPE=27.075%

Week 11, Model RF - Testing Metrics: MSE=15515005.80, MAE=2375.25, RMSE=3938.91, R2=0.861, MPE=-23.532%, SMAPE=38.758%, MAPE=27.637%

Week 11, Model XGB - Training Metrics: MSE=8070373.59, MAE=1739.20, RMSE=2840.84, R2=0.928, MPE=-17.651%, SMAPE=29.242%, MAPE=22.010%

Week 11, Model XGB - Testing Metrics: MSE=10117901.92, MAE=1911.20, RMSE=3180.86, R2=0.909, MPE=-19.560%, SMAPE=31.860%, MAPE=23.450%

6052/6052 _____ 2s 271us/step

2594/2594 _____ 1s 268us/step

Week 11, Model LSTM - Training Metrics: MSE=22727343.70, MAE=2841.28, RMSE=4767.32, R2=0.797, MPE=-15.793%, SMAPE=43.108%, MAPE=33.945%

Week 11, Model LSTM - Testing Metrics: MSE=22466803.84, MAE=2831.69, RMSE=4739.92, R2=0.799, MPE=-15.857%, SMAPE=42.985%, MAPE=33.911%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6052/6052 _____ 1s 226us/step

2594/2594 _____ 1s 223us/step

Week 11, Model NN - Training Metrics: MSE=21066537.67, MAE=2805.89, RMSE=4589.83, R2=0.811, MPE=-38.176%, SMAPE=52.438%, MAPE=33.740%

Week 11, Model NN - Testing Metrics: MSE=20922871.83, MAE=2797.13, RMSE=4574.15, R2=0.812, MPE=-38.180%, SMAPE=52.204%, MAPE=33.670%

Processing model for week 12

Week 12, Model LR - Training Metrics: MSE=36082172.68, MAE=3690.38, RMSE=6006.84, R2=0.677, MPE=-74.917%, SMAPE=91.169%, MAPE=45.557%

Week 12, Model LR - Testing Metrics: MSE=36800395.94, MAE=3700.54, RMSE=6066.33, R2=0.670, MPE=-75.590%, SMAPE=91.677%, MAPE=45.689%

Week 12, Model Ridge - Training Metrics: MSE=36218379.13, MAE=3837.04, RMSE=6018.17, R2=0.676, MPE=-81.913%, SMAPE=98.418%, MAPE=47.381%

Week 12, Model Ridge - Testing Metrics: MSE=36840009.11, MAE=3844.61, RMSE=6069.60, R2=0.670, MPE=-82.612%, SMAPE=98.929%, MAPE=47.503%

Week 12, Model Lasso - Training Metrics: MSE=36082182.89, MAE=3691.50, RMSE=6006.84, R2=0.677, MPE=-74.975%, SMAPE=91.228%, MAPE=45.572%

Week 12, Model Lasso - Testing Metrics: MSE=36799558.04, MAE=3701.64, RMSE=6066.26, R2=0.670, MPE=-75.649%, SMAPE=91.736%, MAPE=45.704%

Week 12, Model DT - Training Metrics: MSE=21764842.45, MAE=2802.89, RMSE=4665.28, R2=0.805, MPE=-32.208%, SMAPE=48.854%, MAPE=32.541%

Week 12, Model DT - Testing Metrics: MSE=22369425.43, MAE=2823.72, RMSE=4729.63, R2=0.800, MPE=-32.794%, SMAPE=49.434%, MAPE=32.774%

Week 12, Model RF - Training Metrics: MSE=14328530.66, MAE=2312.90, RMSE=3785.30, R2=0.872, MPE=-22.666%, SMAPE=37.804%, MAPE=27.268%

Week 12, Model RF - Testing Metrics: MSE=15881373.73, MAE=2402.91, RMSE=3985.14, R2=0.858, MPE=-23.998%, SMAPE=39.453%, MAPE=28.075%

Week 12, Model XGB - Training Metrics: MSE=7820159.43, MAE=1728.28, RMSE=2796.45, R2=0.930, MPE=-17.433%, SMAPE=29.058%, MAPE=21.957%

Week 12, Model XGB - Testing Metrics: MSE=10236692.92, MAE=1917.41, RMSE=3199.48, R2=0.908, MPE=-19.551%, SMAPE=31.952%, MAPE=23.566%

6051/6051 _____ 2s 261us/step

2594/2594 _____ 1s 277us/step

Week 12, Model LSTM - Training Metrics: MSE=23180623.92, MAE=3008.99, RMSE=4814.63, R2=0.792, MPE=-40.207%, SMAPE=56.620%, MAPE=36.267%

Week 12, Model LSTM - Testing Metrics: MSE=23498007.58, MAE=3016.45, RMSE=4847.47, R2=0.789, MPE=-40.747%, SMAPE=57.176%, MAPE=36.364%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6051/6051 ————— **1s** 218us/step

2594/2594 ————— **1s** 222us/step

Week 12, Model NN – Training Metrics: MSE=20598809.02, MAE=2760.54, RMSE=4538.59, R2=0.816, MPE=-33.363%, SMAPE=50.072%, MAPE=32.808%

Week 12, Model NN – Testing Metrics: MSE=21184322.26, MAE=2783.66, RMSE=4602.64, R2=0.810, MPE=-34.011%, SMAPE=50.699%, MAPE=32.974%

Processing model for week 13

Week 13, Model LR – Training Metrics: MSE=36758628.46, MAE=3736.74, RMSE=6062.89, R2=0.672, MPE=-76.712%, SMAPE=93.085%, MAPE=45.973%

Week 13, Model LR – Testing Metrics: MSE=35655881.60, MAE=3714.52, RMSE=5971.25, R2=0.679, MPE=-77.136%, SMAPE=93.201%, MAPE=45.919%

Week 13, Model Ridge – Training Metrics: MSE=36892830.28, MAE=3881.20, RMSE=6073.95, R2=0.671, MPE=-83.632%, SMAPE=100.253%, MAPE=47.756%

Week 13, Model Ridge – Testing Metrics: MSE=35809290.63, MAE=3857.52, RMSE=5984.09, R2=0.678, MPE=-84.045%, SMAPE=100.355%, MAPE=47.713%

Week 13, Model Lasso – Training Metrics: MSE=36758638.62, MAE=3737.85, RMSE=6062.89, R2=0.672, MPE=-76.769%, SMAPE=93.144%, MAPE=45.988%

Week 13, Model Lasso – Testing Metrics: MSE=35655995.13, MAE=3715.62, RMSE=5971.26, R2=0.679, MPE=-77.194%, SMAPE=93.260%, MAPE=45.935%

Week 13, Model DT – Training Metrics: MSE=22335454.00, MAE=2841.25, RMSE=4726.04, R2=0.801, MPE=-34.086%, SMAPE=50.788%, MAPE=33.215%

Week 13, Model DT – Testing Metrics: MSE=22152049.61, MAE=2826.55, RMSE=4706.60, R2=0.801, MPE=-34.492%, SMAPE=51.005%, MAPE=33.189%

Week 13, Model RF – Training Metrics: MSE=14306082.86, MAE=2307.74, RMSE=3782.34, R2=0.872, MPE=-22.918%, SMAPE=38.093%, MAPE=27.325%

Week 13, Model RF – Testing Metrics: MSE=15232842.66, MAE=2365.77, RMSE=3902.93, R2=0.863, MPE=-24.093%, SMAPE=39.371%, MAPE=27.886%

Week 13, Model XGB – Training Metrics: MSE=7847177.05, MAE=1724.93, RMSE=2801.28, R2=0.930, MPE=-17.430%, SMAPE=28.961%, MAPE=21.954%

Week 13, Model XGB – Testing Metrics: MSE=9960902.72, MAE=1900.87, RMSE=3156.09, R2=0.910, MPE=-19.509%, SMAPE=31.781%, MAPE=23.478%

6051/6051 ————— **2s** 263us/step

2594/2594 ————— **1s** 284us/step

Week 13, Model LSTM – Training Metrics: MSE=23699944.20, MAE=2973.01, RMSE=4868.26, R2=0.788, MPE=-32.190%, SMAPE=51.861%, MAPE=34.608%

Week 13, Model LSTM – Testing Metrics: MSE=23507398.71, MAE=2959.72, RMSE=4848.44, R2=0.789, MPE=-32.452%, SMAPE=52.015%, MAPE=34.575%

```
/opt/anaconda3/lib/python3.11/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.
```

```
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```
6051/6051 1s 210us/step
```

```
2594/2594 1s 258us/step
```

Week 13, Model NN – Training Metrics: MSE=21572123.43, MAE=2892.22, RMSE=4644.58, R2=0.807, MPE=-46.331%, SMAPE=60.958%, MAPE=36.354%

Week 13, Model NN – Testing Metrics: MSE=21422403.52, MAE=2882.63, RMSE=4628.43, R2=0.807, MPE=-46.692%, SMAPE=61.128%, MAPE=36.345%

6. Summary

Data Selection and Preparation: The dataset was centered on the "w" store, where tables containing features, stores, and sales were merged to create a comprehensive dataset. Columns with high missing values, such as Markdown1-5, were excluded to maintain data integrity. Data normalization was applied to standardize the range of variables, ensuring all features contributed equally to model performance. The dataset was split into training and testing sets, with a 70/30 split to balance model training and validation.

Choice of Algorithms: A diverse set of models was selected, including Linear Regression, Ridge, Lasso, Decision Tree, Random Forest, XGBoost, LSTM, Neural Network. These models cover a range of techniques from linear and regularized regression to tree-based and time-series forecasting, as well as deep learning. The selection aimed to explore different data patterns and relationships within the dataset. XGBoost was chosen for its efficiency and effectiveness in handling diverse data types.

Evaluation Metrics: The models were evaluated using metrics such as MSE, MAE, RMSE, R2, MPE, SMAPE, and MAPE. These metrics provided insights into model accuracy, error magnitude, and percentage errors, which are crucial for assessing forecast performance. SMAPE and MAPE were particularly relevant for financial forecasting, offering insights into the error proportions relative to actual values.

Training and Parameter Tuning: During initial training, some models showed signs of overfitting, indicated by discrepancies between training and testing metrics. To mitigate this, rigorous parameter tuning was conducted, particularly for XGBoost and neural networks. Adjustments to parameters like learning rate, tree depth, and the number of estimators were made to balance bias and variance, leading to improved model performance.

Model Saving and Selection: After training, each model was saved using joblib for future use. XGBoost emerged as the best-performing model, offering a strong balance between accuracy and computational efficiency. The final selection of XGBoost was based on its superior performance across multiple evaluation metrics.

Conclusion: This structured approach ensured the application of appropriate machine learning algorithms, leading to robust predictive models for sales forecasting. The thorough evaluation and refinement process, guided by multiple metrics, resulted in the selection of XGBoost as the most effective model, capable of generating reliable sales forecasts.